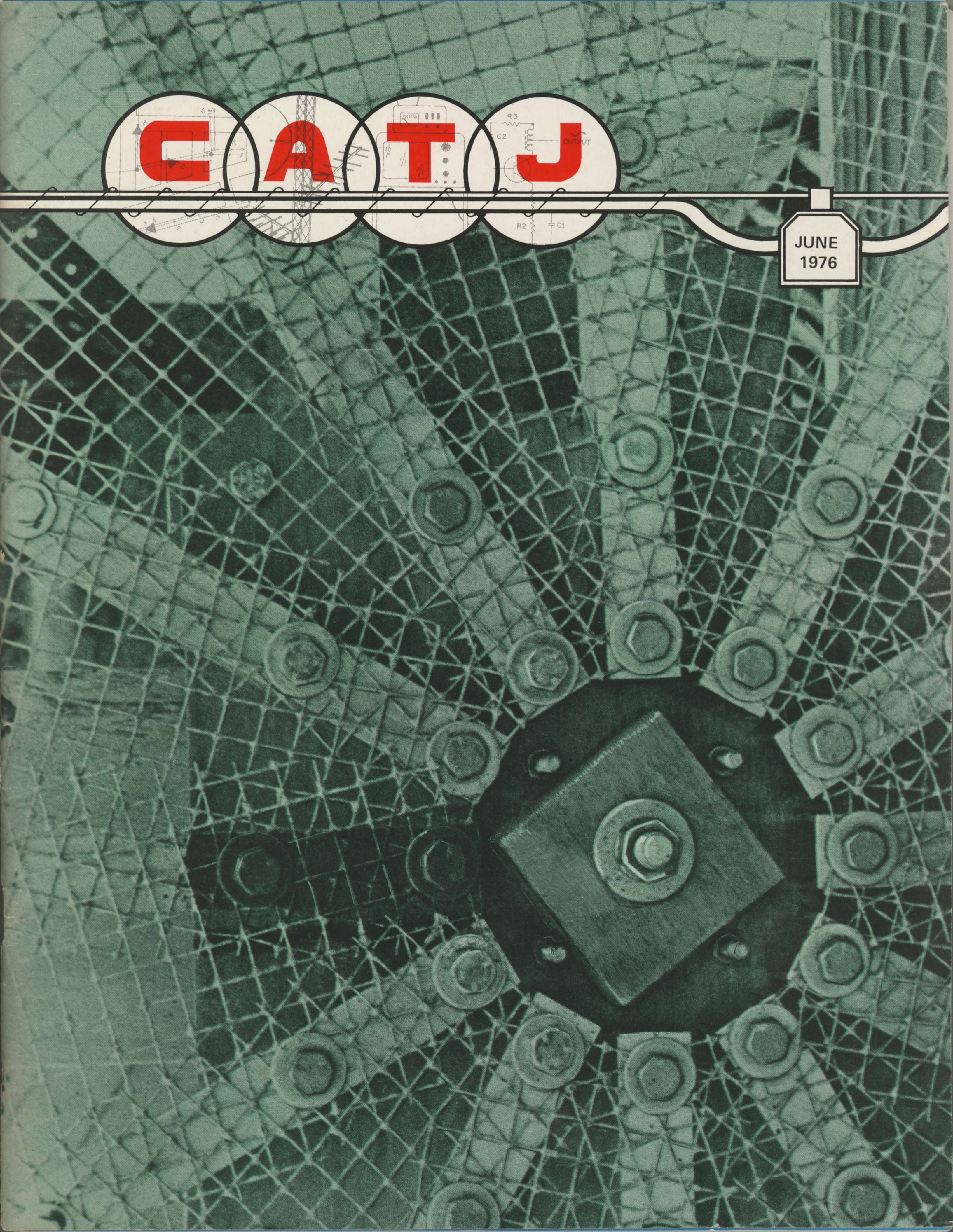
CATJ

JUNE
1976



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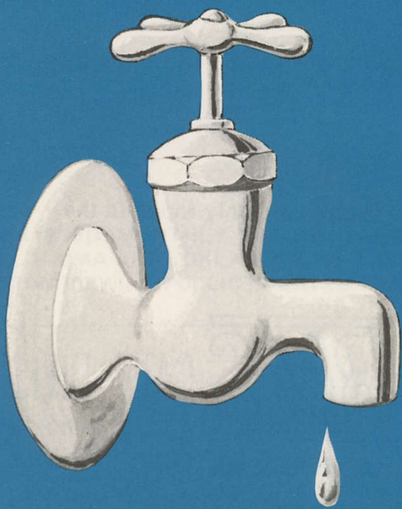

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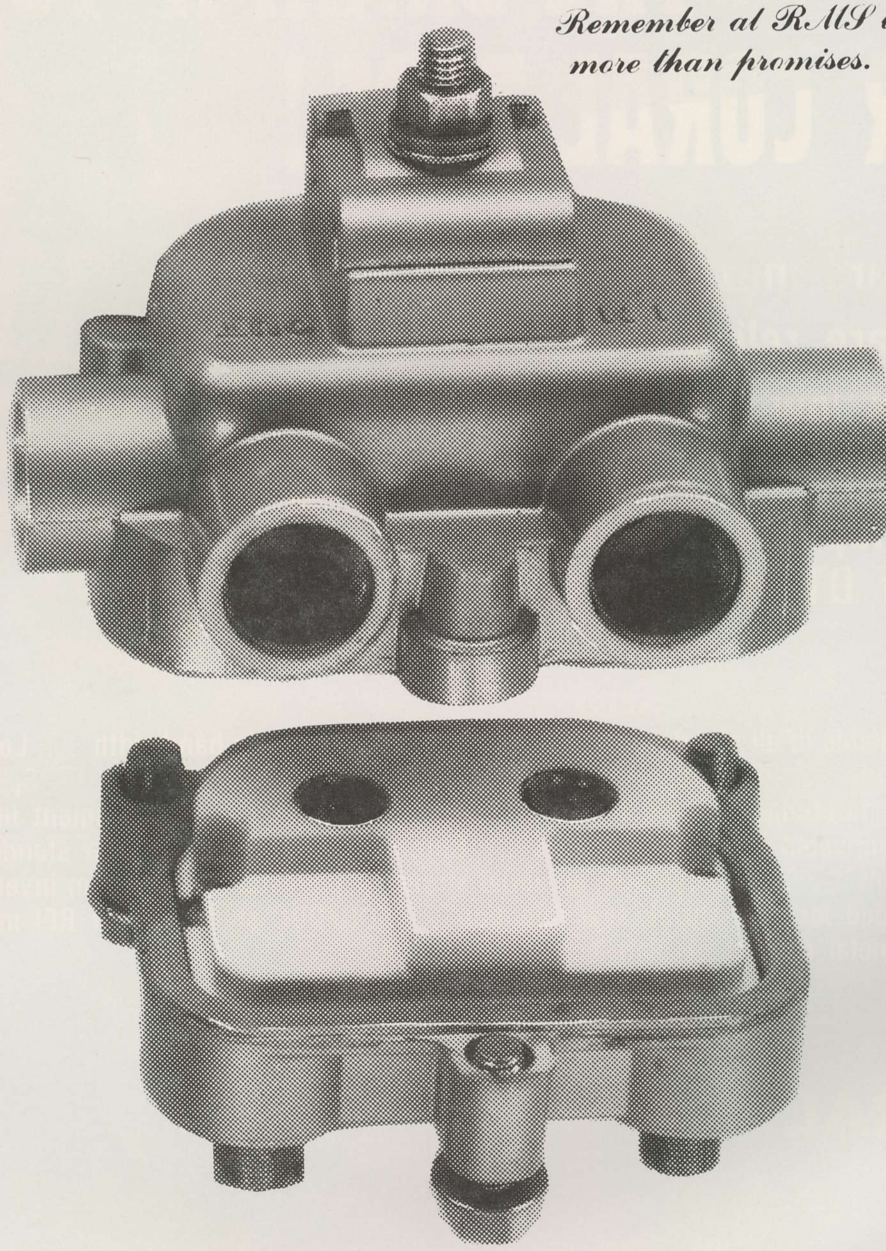

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—CONTENTS—

DEPARTMENTS

OUR COVER

UHF — Techniques for UHF signal delivery are improving all of the time. But the main-stay antenna remains the parabolic dish; a section of a CADCO 8 footer is shown here. Features in CATJ this month include extensive UHF receiving engineering data.

CATA-TORIAL

KYLE D. MOORE, President of CATA, Inc.

AT EACH OTHER'S THROATS

In the April issue of CATJ, our CATA-torial shed light on a subject which surprisingly has received virtually zero-attention from the CATV industry's "news-press". **That subject is franchise raiding.**

Franchise raiding boils down to someone who does **not** have a franchise in your town coming into your community and asking that your city not re-new **your** present franchise, franchising them instead. Seemingly, that is the stuff which competition is made of, and if America has stood for anything through its 200 year history, it has been a **fair** chance for each and every individual to rise to his best level of attainment. That **is** the proper **spirit** of free enterprise, and we have no quarrel with that.

But in the race for competitive position, there are often times "tools available" to one competitor which are not available to a challenger. If the tools are honesty, integrity and "smarts", few of us have any difficulty accepting them. However, if the tools turn out to be under-the-table dealing, unfair use of corporate weight and political influence, then that is quite another matter indeed. It is situations created by the latter which the Justice Department was created to handle many, many years ago.

Very recently a cable television industry publication folded up. There were cries of "unfair" and "foul" as the publication ceased to be, largely brought out by the publisher's contention that numerous advertisers had boycotted his publication because of his editorial policies. Whether the charges would sustain in a competent court of law, or not, may never be known. The charges were made, and the visible evidence nonetheless suggests strongly that the publication did go out of business **largely because** of a lack of adequate advertising support. And within our industry, and from outside looking in whether the charges are prosecuted to a court decision or not, there is the ugly stench of a festering problem which may taint all of the cable industry.

In the April CATA-torial, it was noted that a new type of problem is facing older existing CATV systems who happened to pre-date the March 1972 FCC rules date, systems which were originally given until March 31, 1977 to bring their private contractural agreements with their cities or counties into line with federal guidelines adopted initially in 1972, and refined in the interim. That problem is simply that when you, as a so-called grandfathered operator, go before your local board or commission to seek renewal and re-wording of your current (unexpired) permit, franchise or easement, you face the very real probability that someone not connected with your firm will file a new application in opposition to your application.

That's competition...many would say.

That's what made America great...others would say.

We disagree. America was **not** made great by federal agencies interjecting themselves between a private business person and a local municipal authority. America was **not** made great by allowing federal bureaucracies to step into an existing, functioning, private contract and telling the parties to the contract that they must tear up the agreement and adopt a new agreement based upon new federal guidelines.

We really wonder just why a local municipality would even consider knuckling-under to such federal tactics. In the past, the federal people have moved into local and state matters largely through their power to re-distribute the federally collected tax dollars to local and state authorities. Very few local municipalities and even fewer states have dared fight too long or too hard against a set of federal rules or guidelines when they faced being left out of an annual federal budget allotment. It is the power of the pursestrings personified.

With very few exceptions, we are in direct competition with off-air receivable televison reception. We not only have no exclusive (**read public necessity**) hold on television in the community, we have every possible competitive reason (**read public convenience**) to keep our TV pictures looking as clear as technology will allow.

There is no call for mandatory federal guidelines for cable contracts with the municipalities. This is **another example** in a long series of federal excursions into clearly local matters. It is federal "make-work" of the worse kind, because in the process of making work for themselves and a host of attorneys, the FCC also has created a climate of **risk** for the capital-intensive CATV industry. It is a risk which

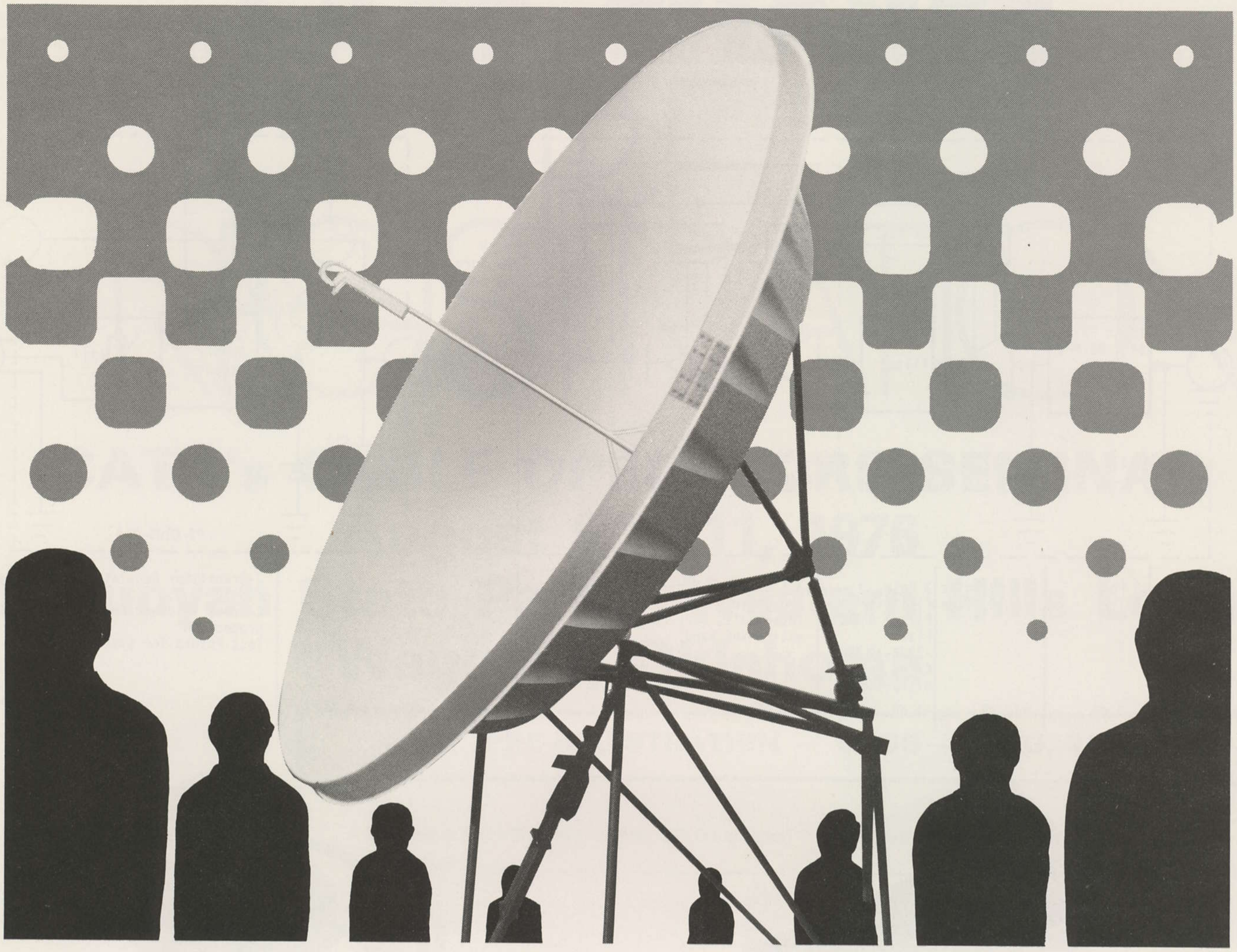
serves no public good, only the private good of creating more paperwork for Washington and more self-made justification for the involvement of the FCC in our purely local affairs.

Accordingly, the Community Antenna Television Association, on May 4, 1976, filed with the Federal Communications Commission a Petition For Rulemaking, in which CATA asked the Commission to cancel its March 31, 1977 franchise compliance deadline date. We have asked the FCC to review the reasons it initially created the 1977 date, and to re-study the rationale behind this 1972 rule decision.

We are hopeful that at an early date the FCC will give serious consideration to this proposal, and will put the proposal out for "rulemaking comments" to the industry, the municipalities and the citizens at large. We are equally hopeful that in such a rulemaking proceeding, every CATV operator will consider what may happen to him and his existing pre-1972 franchised system if this 1972 rule is not changed.

This 1972 FCC rule clearly provides a needless weapon to every would-be "franchise-jumper". It provides the incentive for someone who covets the personal property of another to use the FCC rule as a tool for private gain. This is one tool that has no place in a free-market society and one which a well meaning, but mis-directed federal bureaucracy would do well to suspend at a very early date.

"CLIMBING THESE OLD GRANDFATHERED POLES ALWAYS MAKES ME NERVOUS!"



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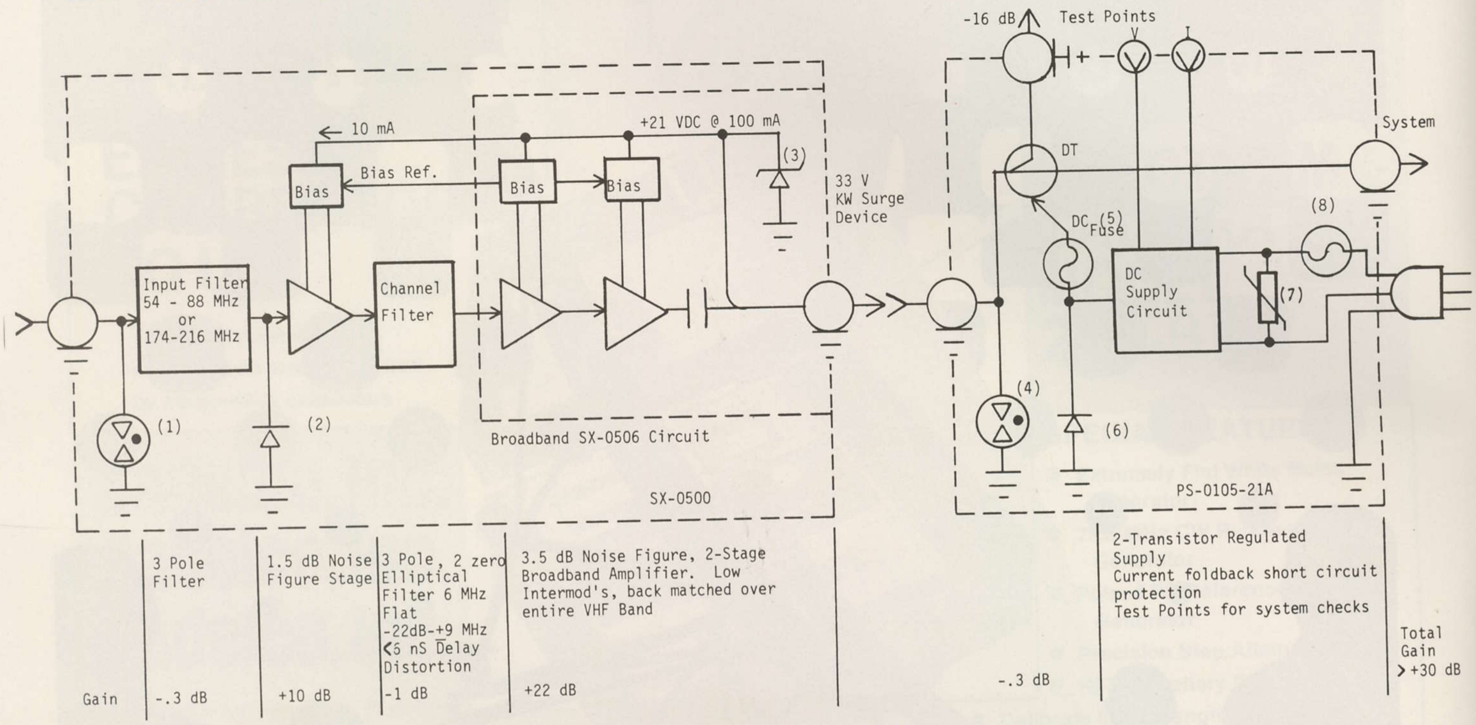

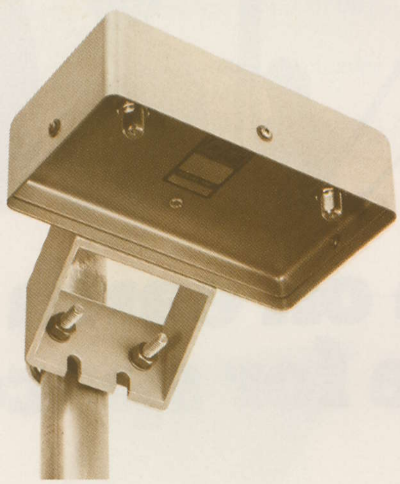

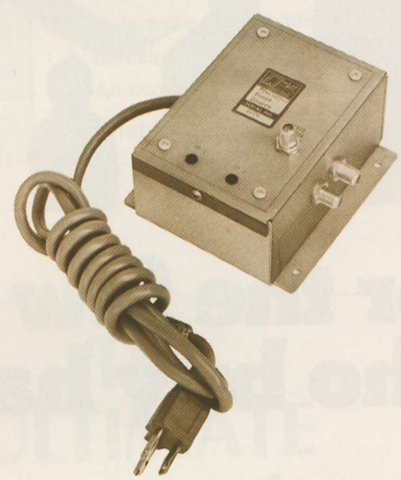

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RALEIGH B. STELLE (III)
On Spectrum Analyzers

The spectrum analyzer has "come of age". It is now a common tool in day-to-day operation of a cable system. What now appears to be lacking is a firm grasp of how these machines function and just what the screen presentations mean.

We're all familiar with the standard broadcast receiver and its operation. As we move the tuning dial, we hear different programs. Each program has associated with it an RF CARRIER WAVE. If we plot a graph of the carrier amplitude versus time for any sinusoidal unmodulated RF carrier, it would look like diagram 1:

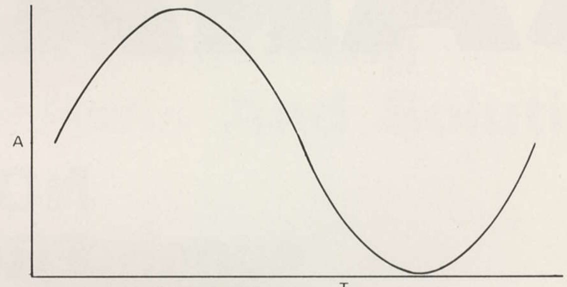


DIAGRAM 1

One unmodulated signal at frequency = 1/T

Several of these carriers may exist simultaneously, so let's plot just two (diagram 2):

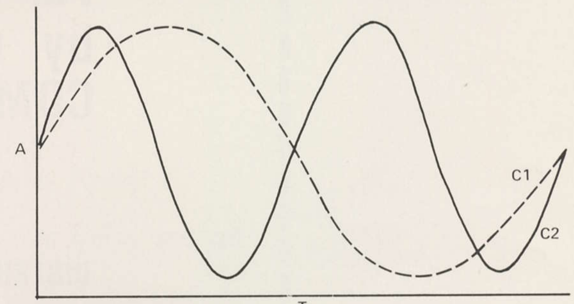


DIAGRAM 2

Two unmodulated signals.

From the graph of two unmodulated carriers versus time, we can see that C2 is twice as fast as C1. We say the frequency of C2 is twice that of C1.

We have plotted both of these in the A (amplitude) vs. T (time) plane. This is called the *time domain.*

Imagine a third dimension to this graph. The dimension extends into and out of the page. An isometric view of this arrangement is shown in diagram 3.

Now, let's put the two signals on our isometric graph (diagram 4).

Also, while we're imagining — let's include a window which moves up the F line and gives us an "end view" of the signals. All we see through the window as we cross C1 and C2 is a line — let's plot them in diagram 5:

This is a plot of two *unmodulated* signals in the *frequency domain.* The term "unmodulated" has

Texscan Sales Engineer Raleigh B. Stelle (III) is not your average CATV salesman. Raleigh is among other things an excellent teacher and a fine electronics author. As the chief yoeman for the Jerrold-Texscan field training seminars on spectrum analyzers, he has educated hundreds of operators on the everyday uses of the industry's fastest growing test equipment appliance, the spectrum analyzer. For months we have been after Raleigh to put together this basic educational treatment of what an SA is and how it works. If you have missed past Stelle-On-Spectrum-Analyzer discourses, you should get away for a couple of days the next time his traveling road show appears in your area. **It is one extremely educational experience!**

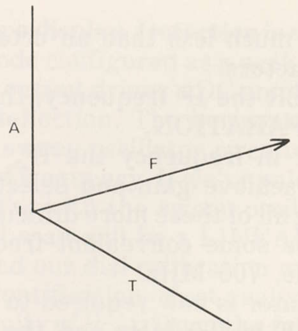


DIAGRAM 3

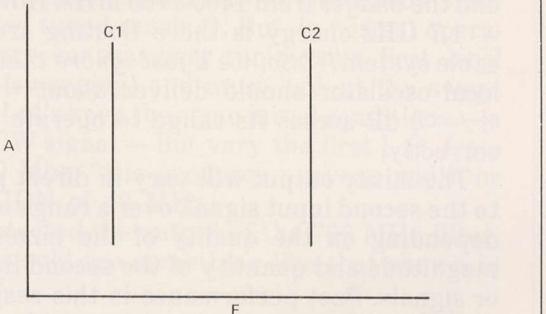


DIAGRAM 4

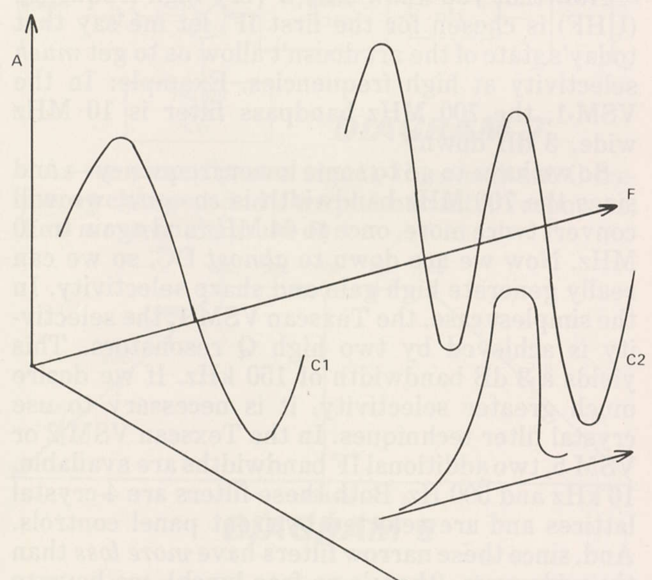


DIAGRAM 5

been stressed because some interesting things happen when the carriers are modulated or the *width* of the window changes. We'll get to those shortly.

Consider the broadcast receiver again. If we rock the tuning dial very slowly back and forth from stop to stop, we would hear each station for a short time as we come to and pass it. Now rock the dial very rapidly — all you hear is gibberish. We have tuned the receiver too fast to derive any auditory information and hear only a series of unrelated pops.

Connect an oscilloscope to the broadcast receiver so that the horizontal scale tracks the tuning knob and the oscilloscope is calibrated in terms of frequency in the horizontal direction.

Connect the speaker terminals (detector/amplifier) to the vertical input of the oscilloscope. Rapidly rock the tuning dial and two things happen on the scope. The horizontal scale moves back and forth and the dot will deflect upward as we pass a station and the detector "sees" the signal.

If this "rocking" is done rapidly, (a few times per second), and *repetitively* we will form a "picture" which we can interpret visually (diagram 5A).

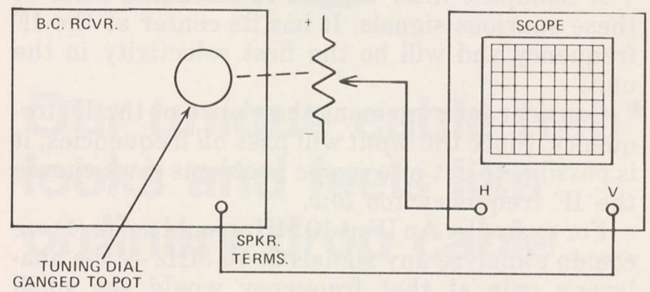


DIAGRAM 5A

Now do the tuning electronically (with varactors) *and we have a basic spectrum analyzer.*

Now, let's take a look at how this magic box does its job (see block-diagram 6). Each block has a specific function to perform and has a particular output for different conditions. Let's examine what happens in our analyzer when we see a *CW signal* at 100 MHz.

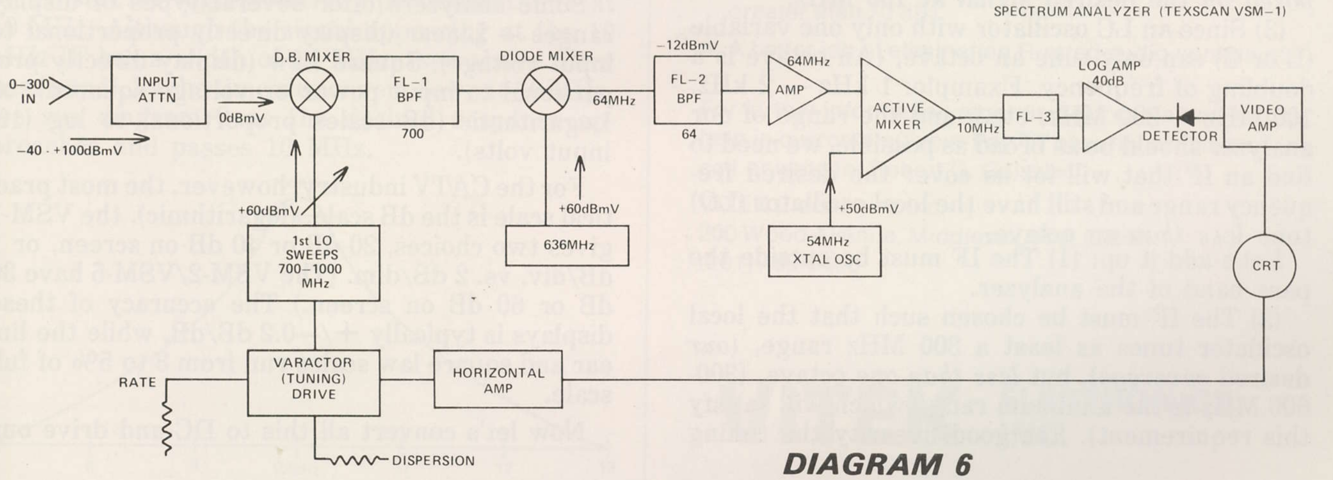


DIAGRAM 6

What happens in the first mixer?

We all know *how* the superhet (standard broadcast) radio works. . .right?. . .Right??. . .*Oh!!* Well, let's see — two signals mix together and produce a third signal which is *different* in frequency from the two original signals, . . .

Let Signal 1 = A = LO frequency
Signal 2 = B – Input frequency

Mixing theory tells us that,

A + B = C, or A – B = C; written A +/– B = C = intermediate frequency or IF.

It would be just great if only that happened, but in the output of the mixer, we may find *several undesired responses*, such as:

2A +/– B = C or, A itself;
3A +/– B = C or, B itself, etc., etc.;
A +/– 2B = C

This problem is obviously multiplied dramatically with multiple signals present at the input; for example, 12 channels plus FM, (etc). These are called spurious responses and we definitely *don't want them* in our analyzer. So we put in a filter (FL-1 in the block diagram).

A bandpass filter is used to attenuate *most* of these spurious signals. It has its center at the IF frequency and will be the first selectivity in the unit.

Consider for a moment the choice of the IF frequency. Since the *input* will pass *all* frequencies, it is possible to get into *image* problems if we choose the IF frequency *too low.*

For example: An IF at 10 MHz would mean (1) we couldn't analyze any signals at 10 MHz — the analyzer's gain at that frequency would see small amounts of signal leakage and cause erroneous readings.

(2) Since we originally stated a single 100 MHz CW signal, let's do the mixing routine.

A = 100 MHz, B = ?, and C = 10 MHz

Since A +/– B = C, A could be either 90 or 110 MHz. Let's choose B = 110 MHz. All is just fine if *only* 100 MHz is present, but — if a 120 MHz signal is also present,

now A = 120 MHz, B = 110 MHz and A – B = 10 MHz

and we see the image response at 120 MHz *superimposed on* the desired signal at 100 MHz.

(3) Since an LC oscillator with only one variable (L or C) can only tune an octave, (An octave is a doubling of frequency. Example: 1 kHz — 2 kHz, 100 MHz — 200 MHz, etc.), and the range of our analyzer should be as broad as possible, we need to find an IF that will let us cover the desired frequency range and still have the local oscillator (LO) tune *less than* an octave.

Let's add it up: (1) The IF must be outside the pass band of the analyzer.

(2) The IF must be chosen such that the local oscillator tunes as least a 300 MHz range, (*our* desired *coverage*), but *less than* one octave, (300-600 MHz is the minimum range which will satisfy this requirement). For good linearity the tuning range should be much less than an octave. Also, consider these factors.

(3) The HIGHER the IF frequency, the greater the IMAGE SEPARATION.

(4) The higher in frequency the IF, the more difficult it is to achieve gain and selectivity.

(5) Considering all of these more difficult factors, arbitrarily choose some convenient frequency.

In our example, 700 MHz.

The local oscillator is now required to tune 700-1000 MHz, the IF is 700 MHz and the unit will respond to desired signals in the 0-300 MHz range *and* the *images* from 1400-1700 MHz. How much 1.4 — 1.7 GHz energy is there floating around *your* cable system??? *So, we'll just ignore that part.* The local oscillator should deliver about +60 dBmV +/— 3 dB across its range to operate the mixer correctly.

The mixer output will vary in direct proportion to the second input signal, over a range of 50-70 dB depending on the quality of the mixer and the magnitude and quantity of the second input signal or signals. Best performance in this respect is obviously with a single signal input (*dream on!!!*).

Now that you know why a very high frequency (UHF) is chosen for the first IF, let me say that today's state of the art doesn't allow us to get *much* selectivity at high frequencies. Example: In the VSM-1, the 700 MHz bandpass filter is 10 MHz wide, 3 dB down.

So we have to go to some lower frequency — and since the 700 MHz bandwidth is *so wide*, we will convert twice more, once to 64 MHz and again to 10 MHz. Now we are down to *almost* DC, so we can really generate high gain and sharp selectivity. In the simplest case, the Texscan VSM-1, the selectivity is achieved by two high Q resonators. This yields a 3 dB bandwidth of 150 kHz. If we desire much greater selectivity, it is necessary to use crystal filter techniques. In the Texscan VSM-2 or VSM-5, two additional IF bandwidths are available, 10 kHz and 500 Hz. Both these filters are 4-crystal lattices and are selected by front panel controls. And, since these narrow filters have *more loss* than the wide ones, (there's no free lunch), we have to add some extra gain to make up this loss.

Some analyzers offer several types of display ranges — Linear (display directly proportional to input voltage), Square Law (display directly proportional to input power or voltage squared), or Logarithmic (dB scales proportional to log (10) input volts).

For the CATV industry, however, the most practical scale is the dB scale, (logarithmic). the VSM-1 gives two choices, 20 dB or 40 dB on screen, or 1 dB/div. vs. 2 dB/dim. (The VSM-2/VSM-5 have 30 dB or 60 dB on screen.) The accuracy of these displays is typically +/—0.2 dB/dB, while the linear and square law scales run from 3 to 5% of full scale.

Now let's convert all this to DC and drive our

oscilloscope display. Detection is accomplished by a simple diode configured as a peak detector and the resultant output drives a DC amplifier to produce a vertical deflection. The horizontal line is derived from the sweep oscillator circuitry and hence is a function of frequency. If we've paid attention to our P's and Q's, with the sweep oscillator design, the horizontal scan will be a LINEAR function of frequency and our dial calibration will suffice for frequency identification. Most analyzer linearities are in the vicinity of +/—1% of the full scale frequency or +/— 3 MHz for the VSM-1.

So far, we have looked only at the steady state case, a *fixed* tuned receiver. But, in normal operation, we are continuously tuning our first local oscillator (sweeping) and must look at the swept response. Let's keep the same initial conditions — a 100 MHz CW signal — but vary the first L.O. from 780 — 820 Mhz. This produces a sweep width or DISPERSION of 40 MHz.

If we detected the output of the 700 MHz filter, FL 1, we would see something like that shown in diagram 7.

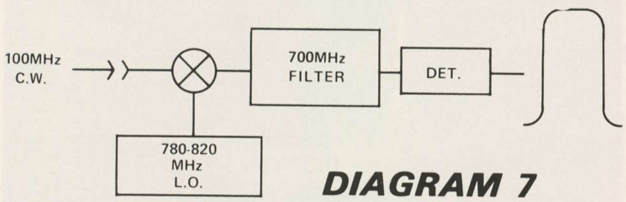


DIAGRAM 7

As we sweep past a signal, the resultant C frequency changed, and if we plot our filter responses, then we see (diagram 8).

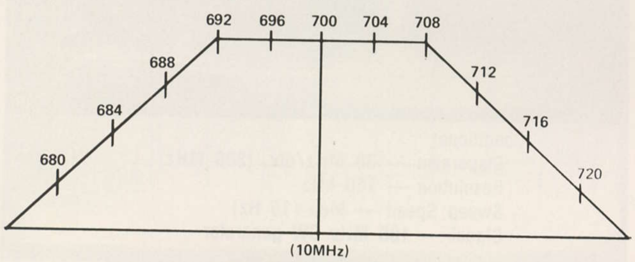


DIAGRAM 8

What we see on screen is the SWEPT RESPONSE of the IF FILTER PASSBAND. Now, let's insert the high selectivity portion of the IF at 10 MHz. Although the signal appearing at the 10 MHz IF has a width of 10 MHz, (see above filter pass band), by the time we convert down to 10 MHz, we see diagram 9 as the desired response approaches and passes 10 MHz.

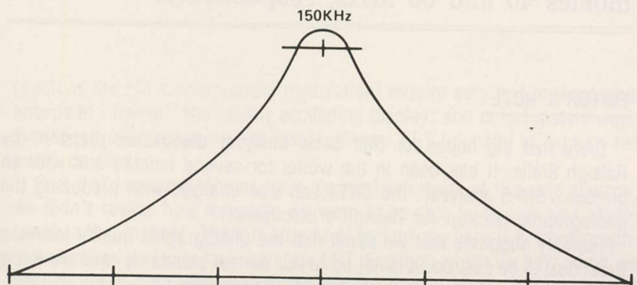


DIAGRAM 9

The 3 dB bandwidth of the IF is generally defined to be the resolution of the analyzer and is the limiting factor in separating signals which are close together in frequency.

We *can* continue this narrowing process until we begin to run into some *limiting factors*. These factors are:

1. *Desired scan speed* (scan loss);
2. First LO residual greater than IF bandwidth;
3. Long term stability won't hold narrow dispersions on screen.

We'll examine these factors one at a time:

Scan loss: A phenomenon related to IF bandwidth, dispersion, and sweep speed (rate). The IF bandwidth requires a certain amount of time to pass the full energy present. If the signal is in the passband for *too short a time*, the energy displayed is *less than* that actually present. This situation is more exaggerated the lower in bandwidth we go.

We can solve scan loss problems by changing any of three parameters: Sweep Speed (too fast), Dispersion (too wide), IF Bandwidth (too narrow). Adjusting any of these items until the amplitude displayed *ceases to increase* assures the operator that scan loss is *not* occurring.

Remember:

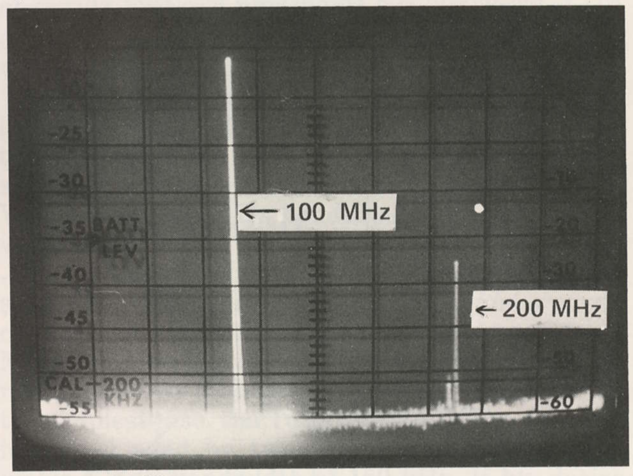
For wide dispersion, use wide IF B/W and *fast* rate.

For narrow dispersions, use narrow IF B/W and *slow* rate.

For the VSM-1, there is a RATE/DISPERSION product which will guarantee that scan loss is not encountered. This number will vary from manufacturer to manufacturer and will also vary with resolution (VSM-1 resolution is fixed at 150 kHz).

Let's stop for a moment and take a short look at the theory of spectrum analysis — not the real heavy, mathy stuff, but everyday pictures you'll see on your machine. Reams of applications notes have been written on the use of spectrum analyzers for specific types of tests, so we won't belabor that here.

First, let's consider our CW signal. In theory, it occupies only one position in the frequency domain — it's an infinitely thin line in the spectrum. But, since the analyzer has finite bandwidth, the CW signal also *appears* to have "width", (depends on the IF B/W . . . remember?), so let's see a picture or two of our CW signal for different analyzer setups. (In each picture, the analyzer conditions will be specified.)



Conditions:
Dispersion — 30 MHz/div. (300 MHz)
Resolution — 150 kHz
Sweep Speed — Med (15 Hz)
Signal — 100 MHz CW generator

Your generator wasn't as clean as you thought it was — these are the harmonics.

If these are harmonics, and we change the frequency of the *fundamental*, the second harmonic moves twice as fast (far) and the third, three times, etc.

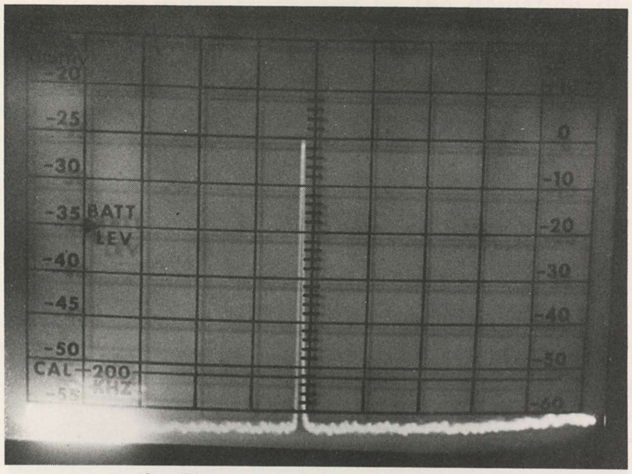
Ex: Fundamental from 100 to 80 MHz
2nd Harmonic from 200 to 160 MHz
3rd Harmonic from 300 to 240 MHz

See, the fundamental changed 20 MHz, the harmonics 40 and 60 MHz, respectively.

EDITOR'S NOTE

CATJ had big hopes for this **basic analyzer discussion** prepared by Raleigh Stelle. It has been in the works for several months and with an on-loan VSM-5 analyzer, the CATJ Lab was charged with producing the photographic backup for Raleigh's discussion.

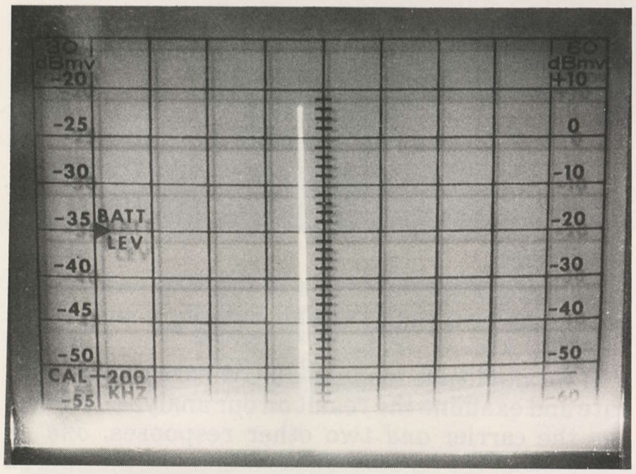
Honesty suggests that we **admit** that the photographic quality leaves a great deal to be desired. It is **not** up to our normal standards, **and we know it!** Many of the photographic shots require **very slow** analyzer scan rates. These are exceedingly difficult to photograph without thickening the display line so that it looks like it was painted with a 2 inch paint brush. Others



Conditions:
Dispersion — 1 MHz/div. (10 MHz)
Resolution — 150 kHz
Sweep Speed — Fast (30 Hz)
Signal — 100 MHz CW generator
Amplitude 0 dBmV

Now we don't see the harmonics because our dispersion (sweep width) is too small, only from 95-105 MHz.

If the picture moves slowly back and forth, or off screen, either the source or the analyzer is drifting.



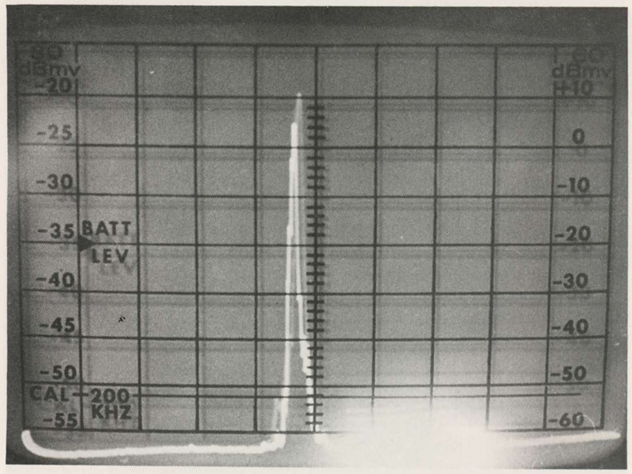
Conditions:
Dispersion — 10 kHz/div. (100 kHz)
Resolution — 10 kHz
Sweep Speed — Med (15 Hz)
Signal — 100 MHz CW generator
Amplitude — 0 dBmV
Phase Lock — Engaged

If the picture now jitters back and forth rapidly, the problem is residual FM in either the source or analyzer. VSM-2/VSM-5 residual FM is 500 Hz or less and will not be visible in this presentation.

(such as the FM carriers under modulation) require **very fast** photographic speeds to ''freeze'' the rapidly oscillating display; and unfortunately when you speed up the camera you lose sufficient CRT intensity to capture the event on film.

Past CATJ analyzer photos have always been made at line-rate sweeps; we didn't realize how fortunate we were to be able to display and photograph in that manner. There is an area of technology here (i.e. photographing very slow and very fast scan rate CRT displays) which we now admit we need to learn more about. And we wanted you to know that we are not happy with the way this turned out.

Whatever you do... don't blame Raleigh!



Conditions:
Dispersion — 1 kHz/div. (10 kHz)
Resolution — 500 Hz
Sweep Speed — Very Slow (5 sec/sweep)
Signal — 100 MHz XTAL OSC.
Amplitude — 0 dBmV
Phase Lock — Engaged

If any residual FM is present, *it will show up now* — with a crystal source, as specified, the analyzer residual FM can be checked. It will appear as a ripple or thickening of the line as shown.

The carrier of an *off air* TV station is crystal controlled and provides a fine source for this test.

The following is a partial listing of spectrum usage up to 300 MHz:

---

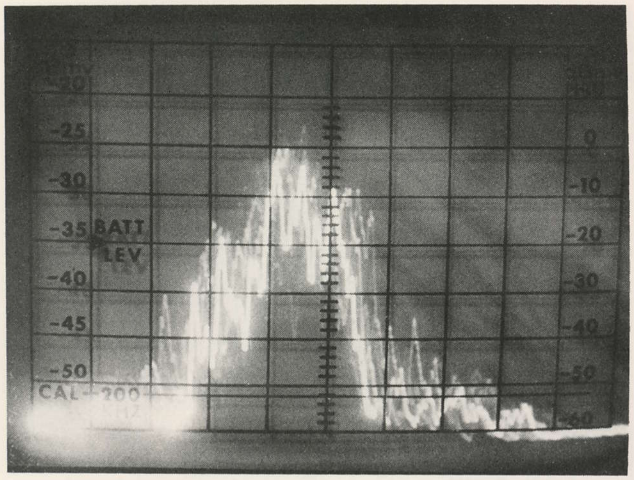
0 — 525 kHz	L.F. Navigation (AM)
.5 — 1.6 MHz	**AM Broadcast (AM)**
1.6 — 30 MHz	Amateur — Military (AM-FM-RTTY, etc.) — Commercial communication — CB — Radio control.
30 — 55 MHz	**Communication (Police-Fire), Amateur, Military**
55 — 73 MHz	TV — Channels 2-4
73 — 76 MHz	**Business band — Radio control.**
88 — 108 MHz	FM Broadcast
108 — 118 MHz	**Aircraft navigation VOR — Localizer (AM-FM)**
118 — 136 MHz	Aircraft communications (AM)
136 — 174 MHz	**Business band (FM) — Satellite telemetry — Amateur**
174 — 216 MHz	TV Channels 7-13
216 — 350 MHz	**Telemetry military — Aviation navigation (glide scope) — Communications (AM-FM) — Amateur**

You may, depending on your geographical location, encounter most of these signals, either as ingress or during signal survey operations or radiation (egress) testing.

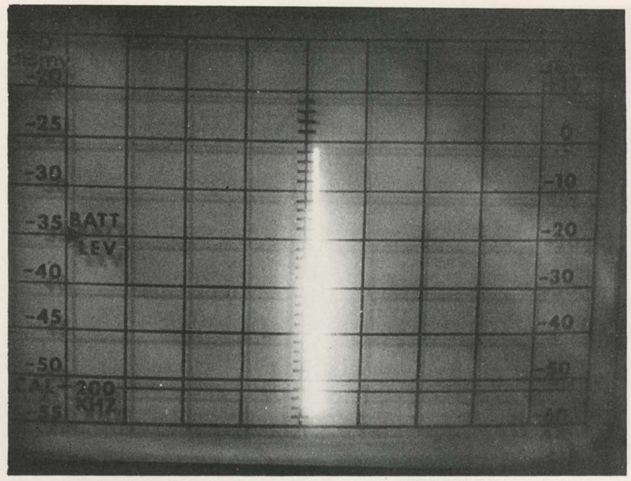
In order to aid your understanding of the analyzer presentation, let's consider some of them in detail.

Let's look at some modulated signals. As we all know, a TV signal is made up of three types of modulation — AM (video), FM (audio), and phase modulation (color) — and, in day-to-day use, you may also see Narrow Band FM, FM Stereo and even radar or aircraft navigation signals.

Let's examine each of these signal types.



Dispersion: 10 kHz/div. (100 kHz)
Resolution: 10 kHz
Sweep Speed: 5-15 Hz (Med)
Signal: Modulated FM Stereo
Amplitude: 0 dBmV
Phase Lock: Engaged



Dispersion: 10 kHz/div.
Resolution: 10 kHz (use 150 kHz for FM broadcast)
Sweep Speed: Select MANUAL (The rate pot sets the spot location)
Intensity: Turn down so as not to burn CRT.
Phase Lock: Engaged
Headphone to Video Out

In our business, we often see FM Stereo broadcast. A regular FM carrier with *no modulation* looks just like our CW signal — but, as the modulation is applied, the carrier "jitters" back and forth and makes a "smeared" presentation. The width of the smear is an indication of the bandwidth occupied by the signal, but it is *not* an accurate measurement. FM deviation can be *measured* with the analyzer, but we won't go into that now.

FM Stereocast has a unique appearance. There are two "side signals" (sidebands) close to the carrier. During "quiet time", (no modulation), we can easily detect these and measure their separation, (19 and 38 kHz, respectively), from the carrier. This cannot be done during program as the picture is too "squiggly". Occasionally, you may note a third subcarrier at 65 kHz spacing. This is the SCA or storecast or MUZAK subcarrier and it is present only on stations offering this service.

Narrow band or communications FM is usually present from HF to VHF. These signals are intermittently present. That is, on and off as the communication is exchanged.

While we're about this, let's determine a way to *listen* to these FM signals. If we *stop* the analyzer *scan*, we have a *fixed-tuned-receiver* with selectivity equal to the IF bandwidth. If we tune it to one of these FM signals, here's what happens:

As the carrier deviates (shifts frequency) it begins to move into and out of the passband. As it moves up and down the IF curve, it shifts in amplitude.

We all know about AM (amplitude with respect to time). If the FM carrier deviates at an audio rate, (it does), then the recovered AM is audio. *A high impedance headphone* or amplifier connected to the VIDEO OUT connector produces an audible signal. The analyzer screen looks like this:

Select *manual* (Auto/Manual switch) and adjust the *rate* control to place the spot on the side of the IF response. As the FM occurs, the spot will "jitter" up and down (AM). *This is slope detection.*

A similar technique is applied to AM broadcast except we stop the spot on the TOP of the response curve instead of the side.

Since we have mentioned AM and FM, let's look at what happens when we modulate our CW signal with AM or FM and see what differences there are. As always, these observations are for a given set of conditions and the display may change for other conditions.

The prime consideration is that the modulation frequency be a constant and initially a sine wave.

First, AM —

If we amplitude modulate a CW carrier at a fixed rate and examine the result on our analyzer, we will see the carrier *and* two other responses, *one on each side of the carrier*. These responses are spaced *away* from the carrier by a distance (frequency) *equal to the modulation rate*. These responses are called *sidebands*. The *amplitude* of these sidebands *is related to the percentage of modulation* as follows:

% AM	Sideband dB
100%	—6 dB
50%	—12 dB
25%	—18 dB
12.5%	—24 dB

If distortion of the sine wave occurs due to overmodulation or nonlinearities in the modulator, harmonics of the modulating frequency appear at regular intervals related to 1, 2, 3 . . . *times the modulating frequency*. The amplitude of these sidebands is *not* easily predictable, but they *should be* lower in amplitude than the fundamental sideband.

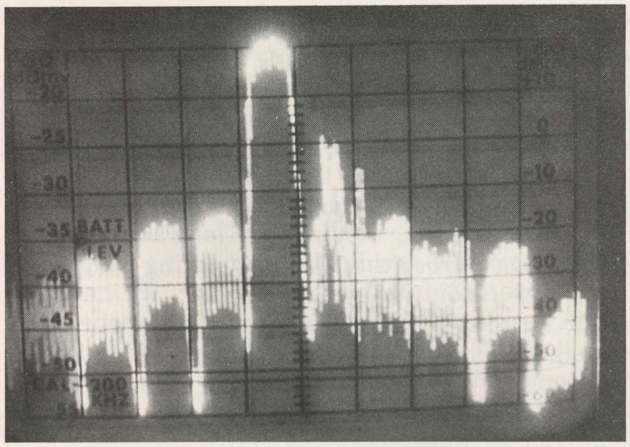
In *Narrow Band FM*, the number of sidebands present *is a function of the modulation index*. The

modulation index is defined as the deviation divided by the frequency of modulation:

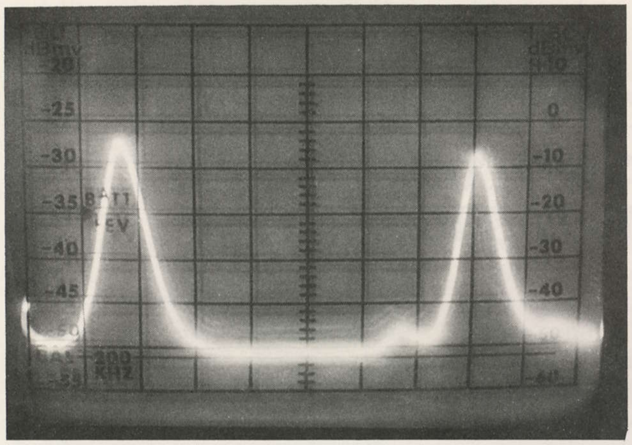
$\beta = \Delta F/fm$ Where β = modulation
ΔF = deviation
fm = modulation frequency

For small B, the FM signal has *only one* significant sideband. As B gets large, (10), the number of sidebands *approaches* the modulation index. So an FM signal *can* require *much more bandwidth* to transmit the *same information* as a similar AM signal. The case of an AM signal with distorted modulation will not be confused with FM because we can observe the "jitter" from FM by using *wider* resolution. This jitter is *not* present on AM.

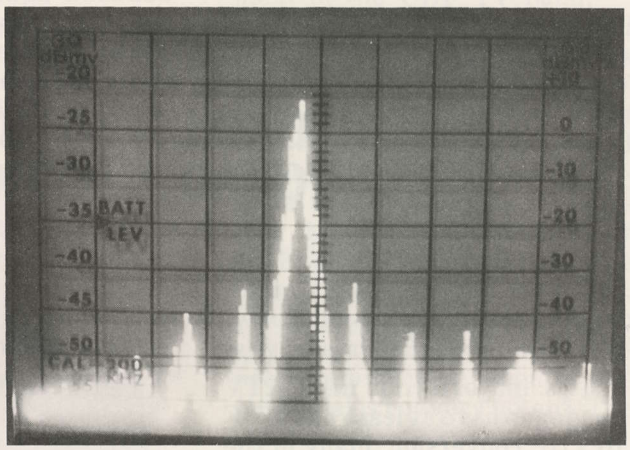
And finally, let's examine a TV picture:



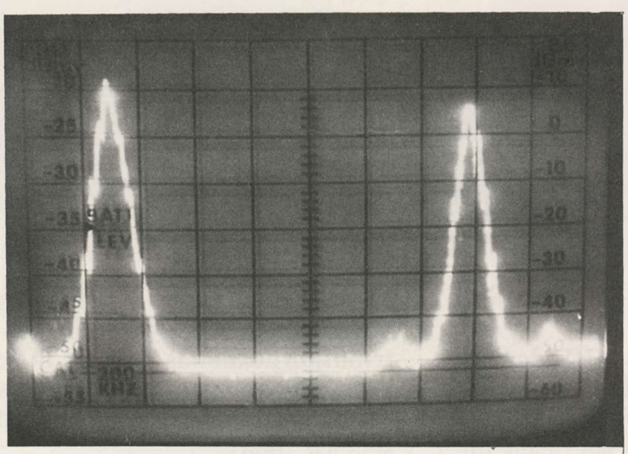
Dispersion: 10 kHz/div. (100 kHz)
Resolution: 10 kHz
Amplitude: Video
Sweep Speed: Med (10 kHz)
Frequency: Channel 4 Video
Phase Lock: Engaged



Dispersion: 1 MHz/div. (10 MHz)
Resolution: 200 kHz
Amplitude: VIDEO/AUDIO
Sweep Speed: Fast
Frequency: Channel 4

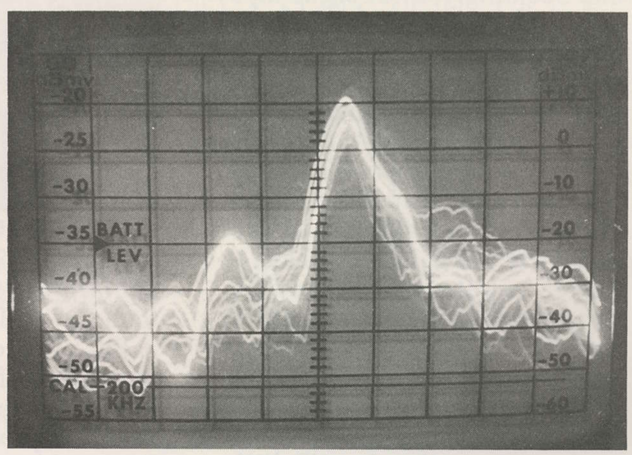


Dispersion: 15 kHz/div.
Resolution: 500 Hz
Amplitude: + 25 dBmV
Sweep Speed: Slow (5 sec/sweep)
Frequency: Channel 4 Video
Phase Lock: Engaged



Dispersion: 1 MHz/div. (10 MHz)
Resolution: 10 kHz
Amplitude: AUDIO/VIDEO
Sweep Speed: Slow (5 Hz)
Frequency: Channel 4

Be careful of scan loss here!



Dispersion: 5 kHz/div.
Resolution: 10 kHz
Sweep Speed: Med (15 Hz)
Amplitude: + 15 dBmV
Frequency: Channel 4 Audio
Phase Lock: Engaged

A few comments are in order for some of these measurements. In measuring the visual carrier, you *must* measure the level of the vertical sync pulse. Depending on the setting of the *rate control*, this pulse will appear to "roll" through the display. Adjust the *rate* to *stop* the pulse for easiest reading. The amplitude of the audio carrier (FM) is just the *peak amplitude* displayed so long as the *resolution* is *much larger* than the modulating frequency.

As our resolution gets *narrower*, we begin to resolve some individual frequency components of the signal. One of the *most* prominent is the 15 kHz horizontal sync pulses. Since this pulse is essentially *square*, it is very rich in *harmonic content* and produces *many sidebands at multiples of 15 kHz.* We just begin to separate these at 10 kHz resolution. At 500 Hz resolution, we can clearly define these sidebands. *Be very cautious of scan loss* during these *narrow* resolution measurements. If necessary, go to manual sweep to verify peak readings. Also note that the peak carrier reading is *6 dB lower* than the reading obtained in the 200 kHz resolution. This is a result of *averaging* the signal information — we are seeing *only* the energy in the carrier, not the carrier plus sideband energy.

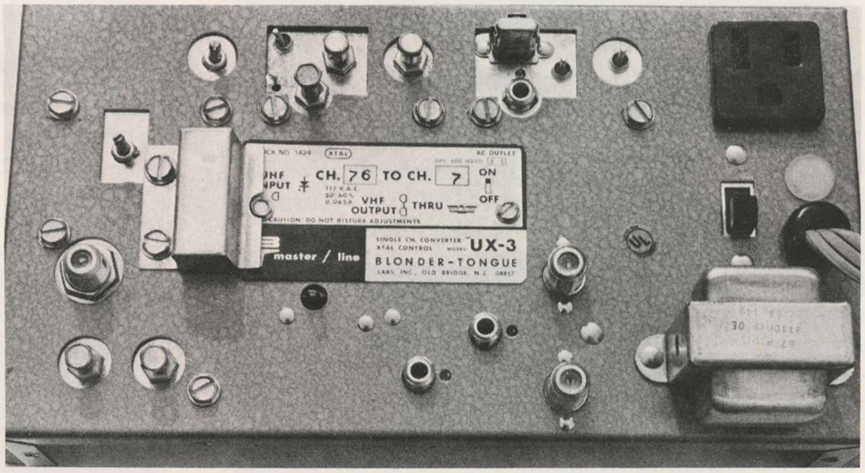
PRACTICAL UHF TO VHF CONVERTER ALIGNMENT/TROUBLE SHOOTING

Thousands In Use

The majority of all CATV headends have at least one UHF to VHF conversion, many in the midwest and east have as many as a half dozen UHF signals carried on the VHF cable frequencies.

UHF will shortly be 25 years old. Seemingly, most of the mystery of the "top band" would have evaporated many years ago under a barrage of technical literature and first hand experience. *Sadly,* that is not so.

UHF is to many still a mysterious band, fraught with uncertainties and difficult to predict. UHF has gained its "hard to tame" reputation largely because the equipment we utilize at UHF is largely VHF gear scaled down in size and the techniques we employ are warmed over VHF in application. UHF wave propagation is still little understood by the average practioner, UHF antennas are usually much too small to be effective and UHF installation techniques often follow the same sloppy (but-who-cares, *it won't show*!) procedures typically found at VHF.



UX-3 CONVERTER — alignment instructions covered in text and diagrams, photographs to follow.

But of all of the UHF devices commonly found in a CATV headend, the UHF to VHF converter is probably the least understood and most "apprehensive" to service part of the CATV U to V chain. And of all UHF to VHF boxes ever produced, the Blonder Tongue UX-3 solid state unit is possibly the most widely used of any in our industry. If one includes MATV installations in the general family of cable distribution headends, there is little if any question that the UX-3 is the most commonly found unit in service today.

The Blonder Tongue UX-3 is approximately 12 years old, nearly half as old as UHF itself. It was one of the first *solid-state* devices to appear in CATV headend circles, and anyone who goes back far enough to tube-type

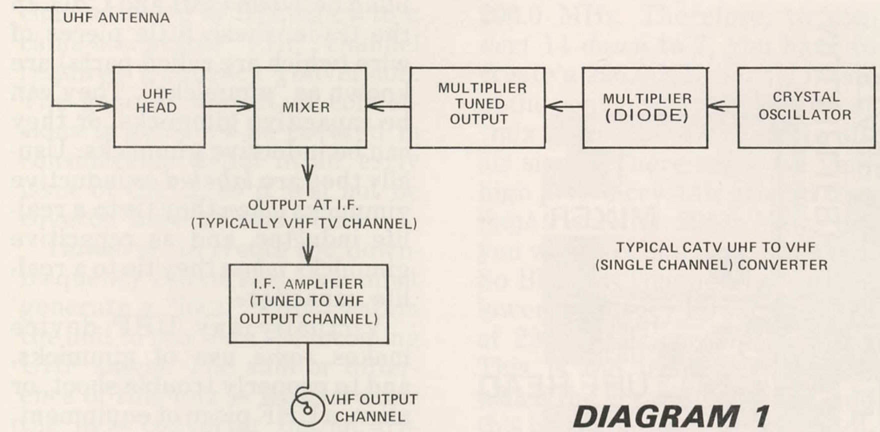


DIAGRAM 1

UHF front ends (and the 6AF4/6AF4A) has reason to appreciate the speed by which BT brought out the solid state version in the 60's. If there was ever an area in television reception techniques that most benefited from consumer application of solid state techniques, that area must be UHF front ends. The *half-life* of the *pre-solid state* UHF local oscillators *seemed to be* about the time it took you to get from the local parts house to the headend; which meant performance of the unit was already deteriorating with the first application of filament voltage to the UHF oscillator tube!

Early CATV users of UHF signals well recall the frequent (sometimes daily) trips to the headend to replace parts or equipment. Perhaps because early day CATV use of UHF was nothing but a series of problems, and the UX-3 (and other units brought out at about the same time) totally or almost totally cured *these problem*-fixing trips, the UHF converter state-of-the-art has largely *stagnated* since the solid state units appeared on the scene. That is, trouble calls *stopped* with the installation of the solid state converters, so the incentive to continue R and D efforts to *improve* the unit's design came to a halt. Thus today, the UHF converters we utilize in CATV are only marginally different in design from those first introduced in 1964 or there abouts.

A Typical Unit

Diagram one is a typical UHF to VHF solid-state converter.

The antenna delivered signal first encounters a "UHF head", which is fancy talk for a preselector. The function of the preselector is largely akin to having a bandpass filter (or passband filter, if you like) at VHF frequencies. The preselector responds by passing-through to the following stage(s) only a chosen *segment* of the UHF TV band.

The UHF head is passive, *and it has loss*, just as any bandpass filter does. Within the U to V converter, *any* signal loss *ahead* of the eventual amplification of the signal degrades the *noise figure* of the total package. Therefore the loss in the preselector UHF head contributes to the noise figure of the converter; which is to say, it contributes to any graininess that might appear in the picture when the input signal is not very potent. The

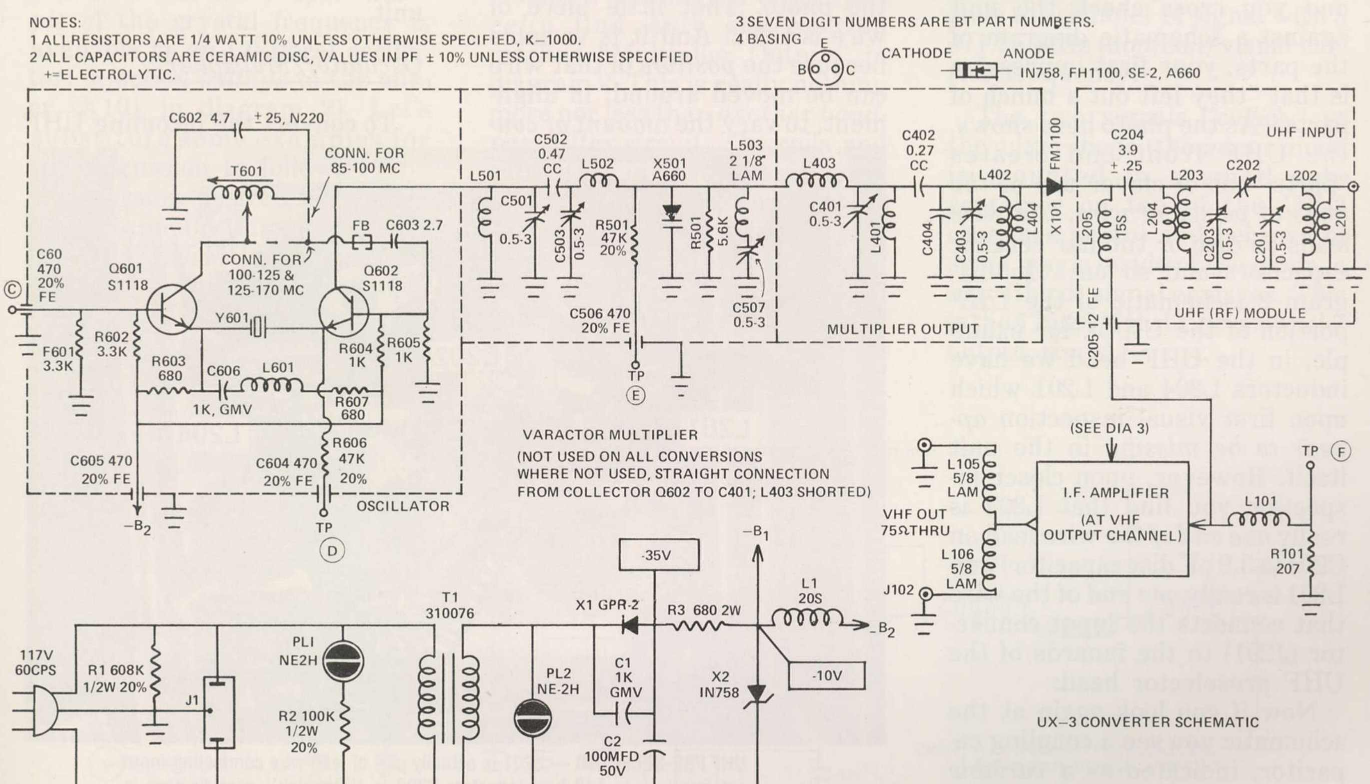
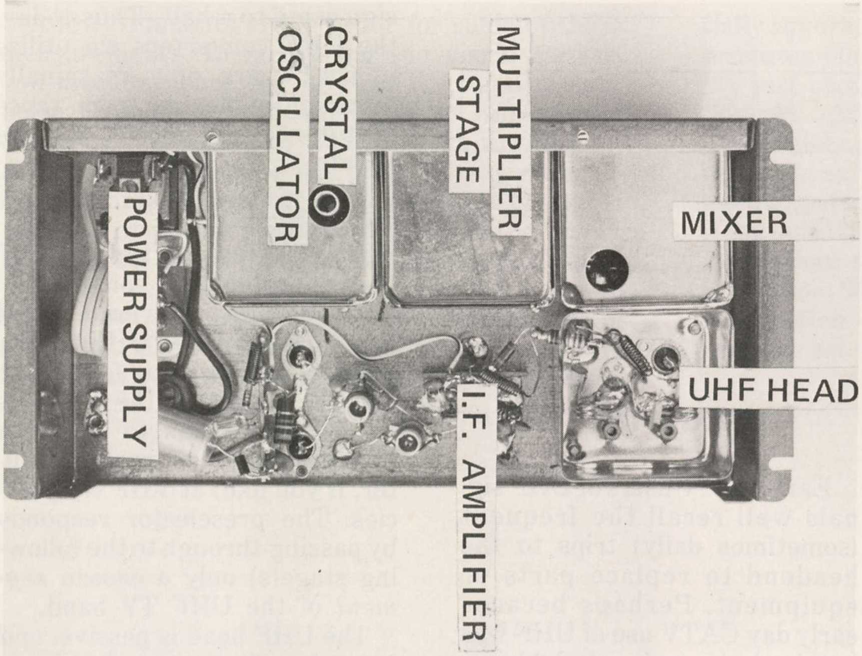


DIAGRAM 2



UX-3 SECTIONS — identifying converter stages.

solution to this particular problem is to place a (relatively speaking) low noise UHF preamplifier *ahead of* the UHF to VHF converter.

The *design* of the UHF preselector head is not much different than a VHF (simple) bandpass filter. However, the *construction* differs considerably. If you have a unit in front of you, *and* you cross check the unit against a schematic diagram of the parts, your first impression is that "they left out a bunch of parts"! As the photo here shows, the UHF front end creates "parts" out of clever use of *the ends* of *pieces of wire*, the wire leads on disc or tubular ceramic capacitors and so on...In diagram 2 (schematic of the *UHF* portion of the UX-3), for example, in the UHF head we have inductors L204 and L201 which upon first visual inspection *appear to be missing* in the unit itself. However, upon closer inspection you find that L204 is really *one end of* the wire lead on C204 (a 3.9 pF disc capacitor) and L201 is really *one end* of the wire that connects the input connector (J201) to the innards of the UHF preselector head.

Now if you look again at the schematic you see a coupling capacitor, indicated as a *variable* capacitor, marked as part C202, coupling *between* C201 and C203 (both are .5 to 3 pF ceramic standup chassis mount units). When you inspect our photograph you find *nothing connects* C201 and C203 together at all! Yet you *know* that somehow signal must get from C201 and C203 or there is no UHF RF getting into the mixer!

Note the little piece of white-covered wire mounted on C201 in the photo. That little piece of wire is C202! And it is variable because the *position* of that wire can be moved around, in alignment, to vary the *amount of coupling* between C201 and C203. In the trade, these little pieces of wire (which are called parts) are known as "gimmicks". They can be capacitive gimmicks, or they can be inductive gimmicks. Usually they are *labeled as* inductive gimmicks *when* they tie to a real-life inductor, and as capacitive gimmicks *when* they tie to a real-life capacitor.

Virtually any UHF device makes *some* use of gimmicks, and to properly trouble shoot, or align, a UHF piece of equipment, you need to appreciate *the function* of *the gimmick*, and to understand that their *position* in "space", *plus* the rigid form they take, determines to a large measure the performance of the stage you are looking upon. So a word of caution is in order: when you are poking around in a UHF device, *don't move seemingly loose ends of "wire" around* with your finger or plastic alignment tool "to get a better look" at what is beneath or around them. The piece of wire you move is not an uncut end to a resistor or capacitor or inductor; it is part of a tuned circuit and when you move the wire end lead around, you have just upset the alignment of that particular section of the unit.

Oscillator/Multiplier

To convert the incoming UHF

UHF PRE-SELECTOR — L201 is actually part of lead-wire connecting input antenna jack to 1/2 turn inductor; C202 is ''gimmick'' wire floating in space between C201 and C203; L204 is wire-lead end on 3.9 pF coupling capacitor, bent into 1/2 turn inductor.

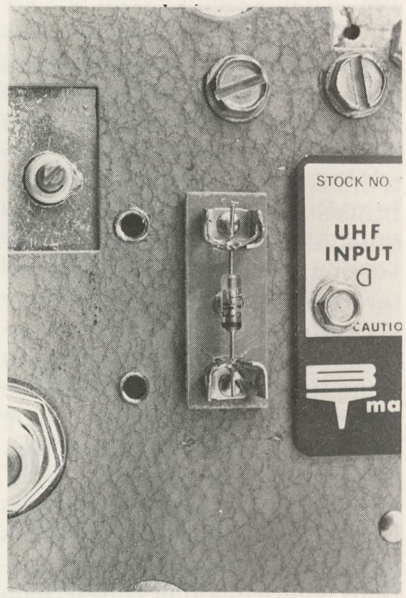
channel down in frequency to a cable-acceptable VHF channel requires frequency conversion. The general subject of conversions is going to be covered in considerable detail in an early issue of CATJ, so it will not be covered here at this point.

However, to create the down-frequency-conversion, we must generate a "local" signal *within* the unit to *mix with* the incoming UHF signal. The sum or difference of this mix is what creates the new converter output frequency, at i.f. (i.e. on a VHF cable carriage channel). To create a *local* signal that is stable requires a *crystal* oscillator. In the UX-3 case, the oscillator circuit is of a little known oscillator-family design that is exceedingly rich in harmonics. That is, the oscillator employed in the UX-3 not only generates a carrier on the crystal frequency, but on mathematical *multiples* of the crystal frequency as well. A variation of this oscillator circuit is found in another popular U to V converter, except L601 (between emitters on Q601/Q602) is *tuned* rather than fixed.

Because the output of the crystal controlled oscillator is rich in harmonics, the *proper multiple* of the crystal frequency is available as an L0 (local oscillator) *injection voltage* to the mixer (X101 in diagram 2). Let's substitute some examples for the discussion to follow.

Coversion desired is channel 14 to channel 7. Channel 14 operates on 471.25 MHz visual carrier frequency, while cable-channel 7 is 175.25 MHz. If you subtract 175.25 from 471.25, you have 296.0 MHz. Therefore, to *convert* 14 *down* to 7, you have to create a 296.0 MHz signal inside of the converter, to beat with or "mix with" the 471.25 MHz off-air signal. There are some very high priced crystals around that *might* work at 296.0 MHz, but you wouldn't like their price tag. So Blonder Tongue generates a lower frequency L0 signal at 1/3 of 296.0 MHz, or 98.666 MHz. This is the frequency (98.666) which the crystal is cut for, and this is the frequency of the oscillator stage (Q601, Q602). Now because the oscillator design is rich in *harmonics of* 98.666 (as well as 98.666), the next trick is to design a tuned circuit to *follow* the *output* of the oscillator which passes *only the desired harmonic* (or 296.0 MHz). This is done in the stage marked "multiplier" in diagrams 1 and 2.

Diagram 2 shows *two* separate multiplier sections. One is marked "Varactor Multiplier", which will be passed over for now. Suffice to say this stage appears only in certain units (i.e. those that have very high UHF channel inputs, such as UHF translator channel inputs), *we'll come back to it in a bit.* In the standard ho-hum UX-3, we *typically* find only the section marked "Multiplier Output" in diagram 2. This is really nothing more nor less than *another band-pass filter* circuit. The coils and capacitors in that stage form a passband circuit that when properly tuned for our example will allow *the 296.0 MHz harmonic* of the 98.666 MHz oscillator to pass through, but *other* harmonics and even the fundamental (on



MIXER DIODE — Normally hidden from view by metal protective cover, snaps into holder (i.e. solderless).

98.666 MHz) *will be attenuated* so as to not be present at the output of the "Multiplier Output" stage.

At this point we have *two* separate signals converging on diode X101, *the mixer diode.* Coming from the output of the "Multiplier Output" we have a 296 MHz signal, and coming from the output of the UHF preselector, we have the channel 14 signal with a 471.25 MHz (nominal) visual carrier frequency.

The two signals "*collide*" at the mixer diode (the mixer diode is mounted in a small sub-container on top of the UX-3 case; see photo) and because of some magic inside of the diode, a *new* (third) signal emerges. This is the 175.25 MHz i.f. or channel 7 output signal.

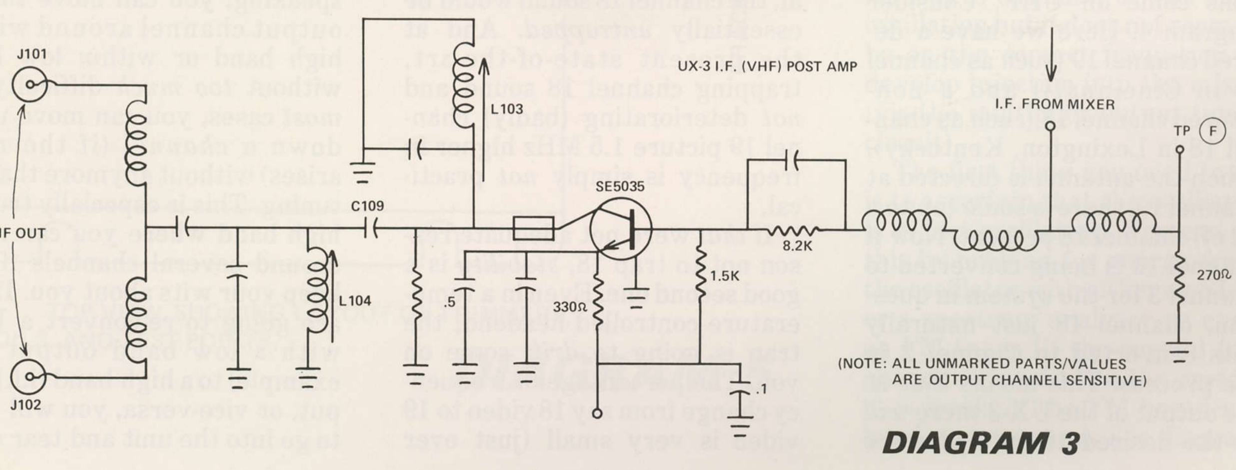


DIAGRAM 3

I.F. Amplifier

The *output* of the mixer diode passes through L205 (see photo of UHF preselector container) and goes onto the *input* of the transistor i.f. amplifier. The transistor i.f. amplifier is often called a "post amplifier" in conversion circles; post meaning after conversion. This is a fairly straight-forward single stage amplifier (see diagram 3) with some tuned circuits to cause the stage to be as close to single channel in response as possible. The UX-3 has twin i.f. (VHF channel) output terminals largely in difference to the unit's widespread use in MATV systems where installers often "loop through" multiple *non*-adjacent channels as a means of combining channels at the headend before sending all of the signals into the "system" distribution plant. In CATV use, the loop-thru second i.f. output connector is seldom of any practical use, and it should *always* be terminated with a 75 ohm termination. Both output fittings have the same identical signal present, which means either one can be terminated, and the other used.

Need More Selectivity?

As we shall see shortly, the front end selectivity of a UHF converter is not great, especially for the immediate adjacent channel on both sides. The FCC has obliged us in most circumstances by not assigning too many adjacent channel UHF situations between adjacent markets, but there are more problems in this area every month as new stations come on UHF. Consider diagram 4. Here we have a desired channel 19 (such as channel 19 in Cincinnati) and a non-desired channel 18 (such as channel 18 in Lexington, Kentucky). When the antenna is directed at channel 19, there is some (up to *a lot* of) channel 18 present. Now if channel 19 is being converted to channel 3 for the system in question, channel 18 just naturally gets converted to channel 2 in the process. This means that at the output of the UX-3 there *will be* the desired 19 on 3 *plus* the *non*-desired 18 on 2 (diagram 4-A).

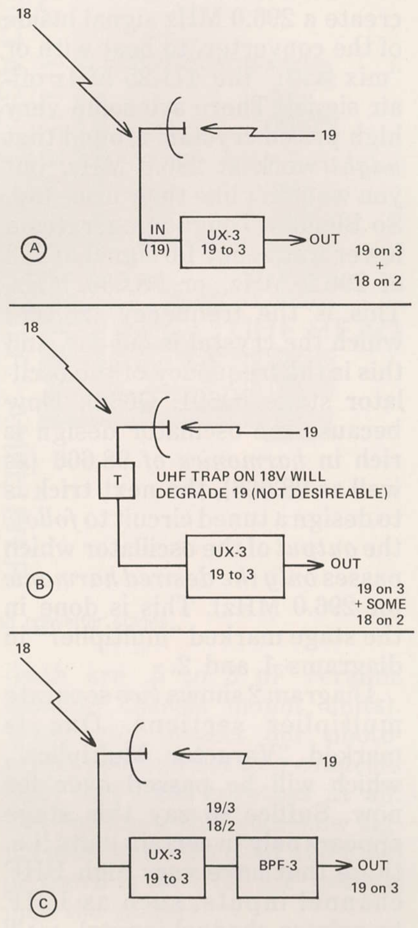


DIAGRAM 4

You could go in *ahead of* the UHF converter with a channel 18 *trap*, but that is not advisable for two reasons. The first is selectivity, most if not all common variety UHF traps are simply not sufficiently selective to trap down 18 video and *leave* 19 video *alone*. Selectivity at UHF comes *very* hard. Even if you were reasonably successful in trapping the channel 18 visual carrier 6.0 MHz lower than channel 19 visual, the channel 18 sound would be essentially *untrapped*. And at the present state-of-the-art, trapping channel 18 sound and *not* deteriorating (badly) channel 19 picture 1.5 MHz higher in frequency is simply *not* practical.

If *that* were not adequate reason not to trap 18, *stability* is a good second one. Even in a temperature controlled headend, the trap is going to *drift* some on you. The percentage of frequency change from say 18 video to 19 video is very small (just over 1%) and to expect the channel 18 video-centered trap to *stay on* 18 visual *all* of the time is just too much to expect. So the approach shown in diagram 4-B is really not very acceptable, in most situations. If you *have to have* a UHF pre-amp *on the tower* for the distant channel 19, in this situation, you certainly could *not* get by with the UHF trap *up on the tower* also, subject to the wide temperature extremes (i.e. trap drift) one would normally expect on the tower.

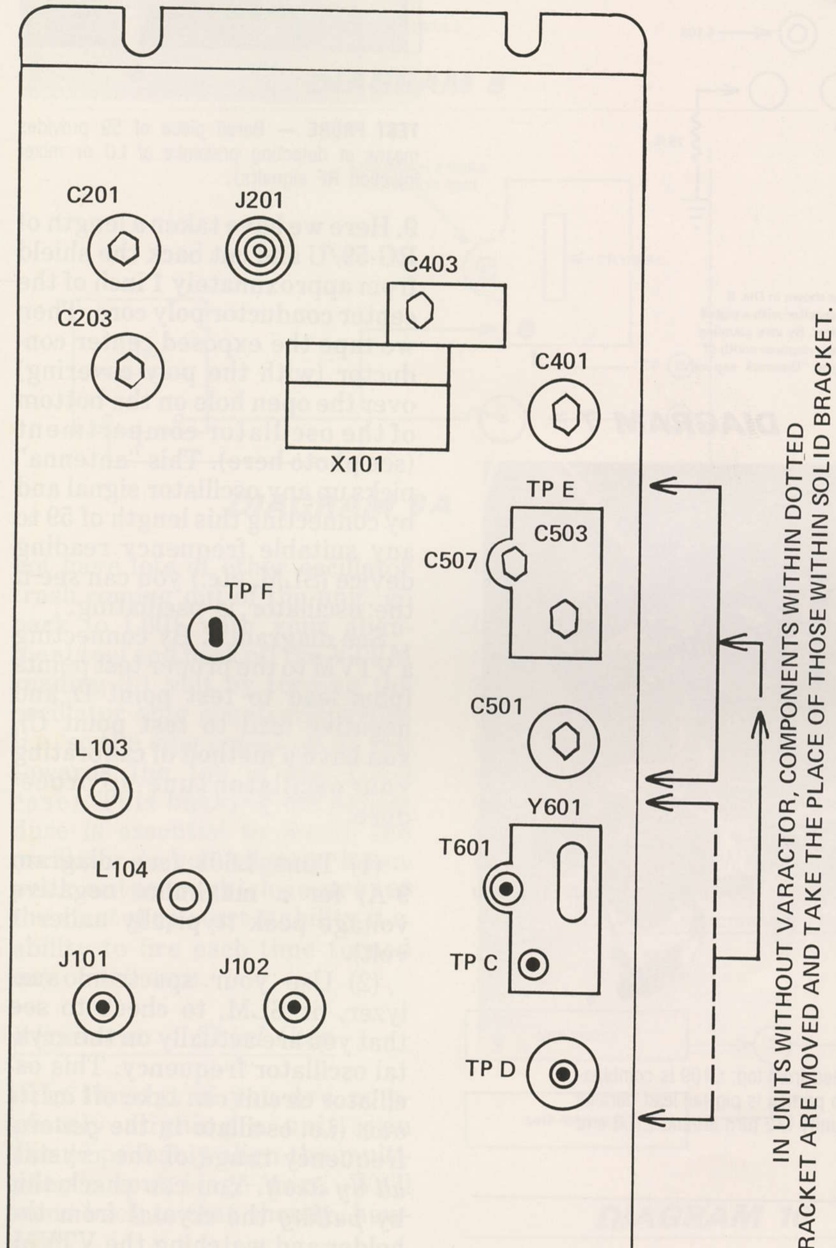
So that leaves the solution found in diagram 4-C, a VHF bandpass filter system installed *after* the UX-3. A stable channel 3 BPF is no trick these days, and *it* can be used to eliminate the channel 18 on 2 signal *after* the UX-3 to solve the problem. This all assumes that (1) if you have a need for a UHF pre-amp, that the pre-amp is capable of handling *both* the 18 and 19 signals with*out* overload, (2) the total amplified signals from 18 and 19, converted through the UX-3 to 2 and 3 respectively, will *not* overload the signal handling capability of the UX-3. It, like any active device, has practical signal handling limitations.

Alignment-First Step

Anyone with VHF sweep equipment can align the VHF i.f. post amplifier without much difficulty. The UX-3 i.f. has a fairly large number of component parts which are i.f. output channel sensitive. In diagram 3, all unmarked parts are a little or a lot dependent upon the output frequency chosen. Generally speaking, you can move the i.f. output channel around with*in* high band or with*in* low band without *too much* difficulty. In *most* cases, you can move up or down *a channel* (if the need arises) without anymore than retuning. This is especially true on high band where you can move around several channels if you keep your wits about you. If you are going to re-convert a UX-3 with a low band output (for example) to a high band (i.f.) output, or vice-versa, you will need to go into the unit and tear out a

bunch of coils and capacitors to make the big jump up or down in frequency.

To align or retune the i.f. post amplifier, you need to inject a test signal into the i.f. (VHF output channel) section of the unit. This is done by preparing a test jig adapter to go on the end of your sweep source cable (diagram 6) to inject the sweep signal (with markers) into the UX-3 via the mixer diode (take *it out* and connect the test jig in its place across the mixer diode mounting clips). The sweep horizontal drive goes to the display scope in the normal fashion, and the detector-bound output of the i.f. amp is taken out of either of the twin output connectors on the UX-3 (terminate the unused output port). See diagram 7.



UX-3 TOP VIEW, SHOWING LAYOUT OF TRIMMERS, COILS, AND TEST POINTS.

DIAGRAM 5

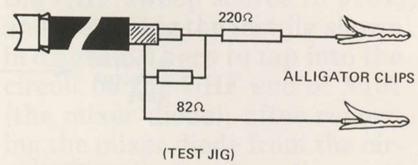


DIAGRAM 6

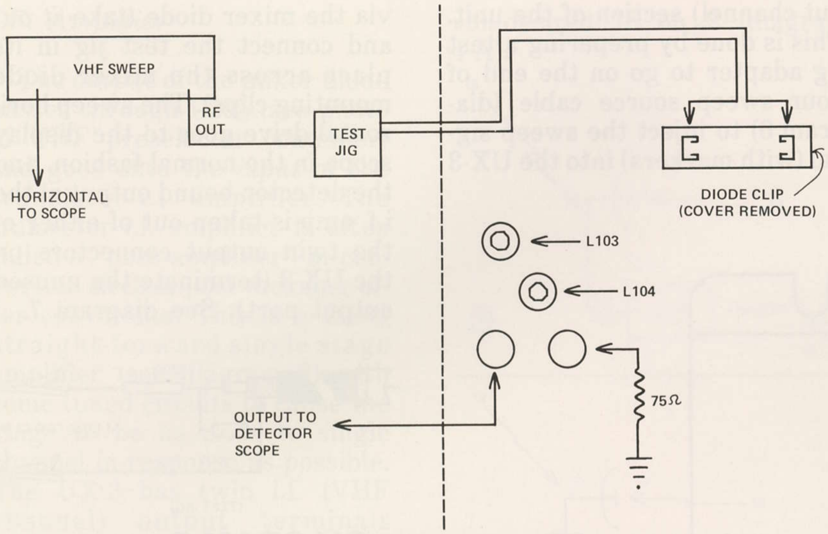
(1) Align L103, L104 and C109 for the best bandpass response for the channel in question. See diagram 8.

(2) Note that L103 and L104 come out of the top of the UX-3 container (see diagram 5 and 7); while C109 is another one of those *gimmicks* (see photo). This one is a pigtail lead that wraps *around* the coupling capacitor between L103 and L104. The actual amount of inter-tuned-circuit coupling from L103 *to* L104 (diagram 3) is determined by both the fixed value of the tubular ceramic capacitor *and* by the amount of pigtail lead *exposed to* the L103 side of the twin tuned circuits. Varying this pigtail lead effects the *width* of the channel response (i.e. more or less than the single channel desired).

Alignment — Second Step

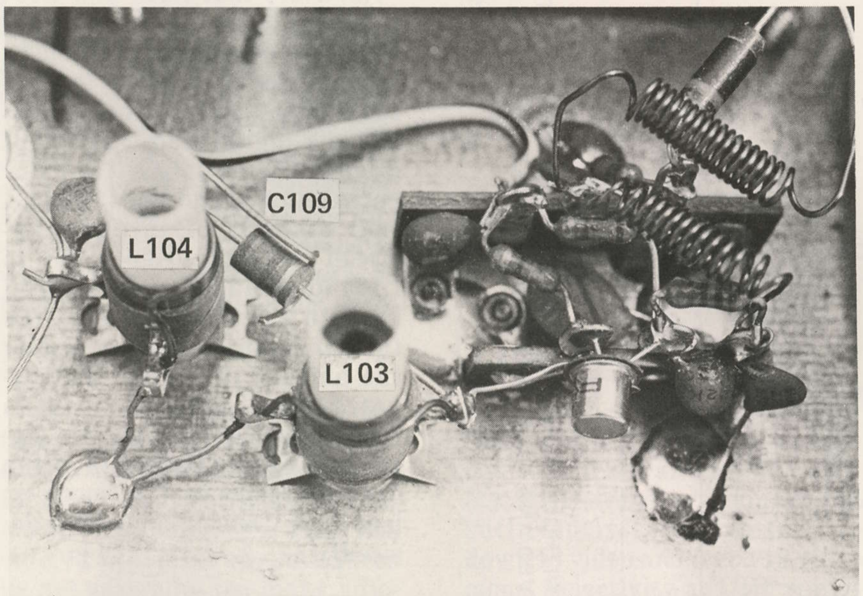
Now suppose you have an oscillator problem, that is, the unit refuses to oscillate, or you have oscillation but it does not seem to be on the correct frequency to develop injection into the mixer (via the multiplier output tuned circuit).

The first thing you need to do is to ascertain that the oscillator is in fact oscillating. You can do this by probing for energy from the oscillator with either an SLM or a spectrum analyzer or even an FM tuner (if the crystal frequency — *marked on the crystal* — is *inside of* the FM broadcast band, as many are). See diagram



1) Align L103, L104 and C109 for response shown in Dia. 8
Note: C109 is a fixed ceramic tubular Capacitor with a pigtail "Gimmick" coupling lead around Capacitor. By vary coupling of "Gimmick" lead, you vary the bandpass response width of VHF/I.F. Amplifier, Increasing coupling on "Gimmick expands bandpass response width.

DIAGRAM 7



I.F. TUNING — L103, L104 are slug-adjusted from top; C109 is combination "fixed" **and** adjustable. The adjustable portion is pig-tail lead parallel to body of capacitor, and wrapped (in this unit) 1/2 turn around L103 end of fixed capacitor.

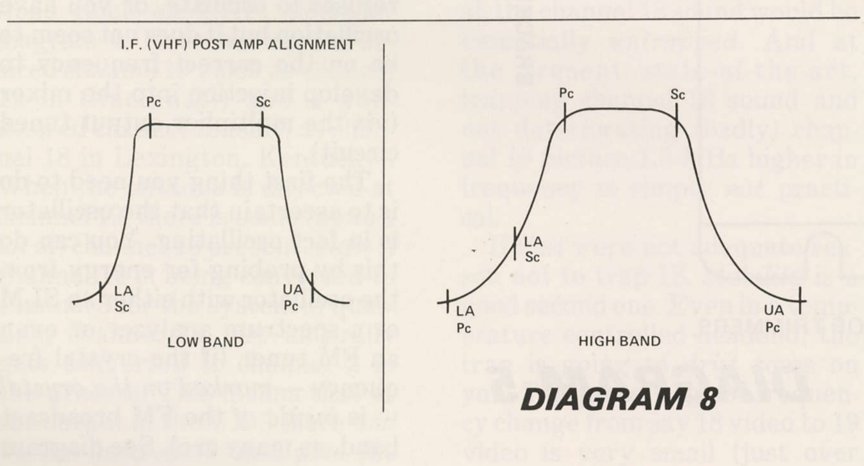
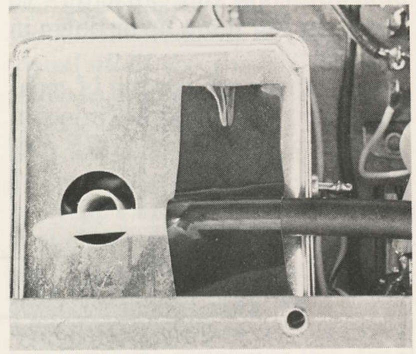


DIAGRAM 8



TEST PROBE — Bared piece of 59 provides means of detecting presence of LO or mixer injection RF signal(s).

9. Here we have taken a length of RG-59/U and cut back the shield from approximately 1 inch of the center conductor poly core. Then we tape the exposed center conductor (with the poly covering) over the open hole on the bottom of the oscillator compartment (see photo here). This "antenna" picks up any oscillator signal and by connecting this length of 59 to any suitable frequency reading device (SLM, etc.) you can see if the oscillator is oscillating.

See diagram 9. By connecting a VTVM to the proper test points (plus lead to test point D and negative lead to test point C), you have a method of calibrating your oscillator tune-up procedure.

(1) Tune L601 (see diagram 9-A) for a maximum negative voltage peak (typically under 1 volt).

(2) Use your spectrum analyzer, or SLM, to check to see that you are actually on the crystal oscillator frequency. This oscillator circuit *can* take off *on its own* (i.e. oscillate in the *general* frequency range of the crystal) *all by itself*. You can check this by *pulling* the crystal from the holder and watching the VTVM. If the VTVM voltage changes, the crystal *was* oscillating. If it does not, it was the circuit oscillating all by itself.

(3) IF the oscillator frequency is at the low end of the oscillator range (85-100 MHz) you may have to spread the turns on L601 to get the oscillator to oscillate properly.

(4) Finally, having confirmed that it is the crystal that is oscillating and confirming that you do

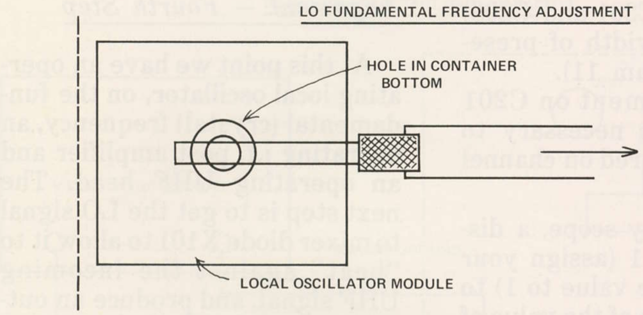


DIAGRAM 9

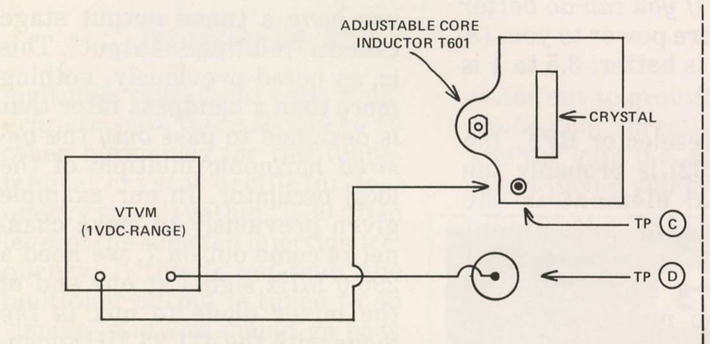


DIAGRAM 9A

not have lots of other oscillator trash coming out of the unit, go back to L601 with your alignment tool and back off the VTVM reading 0.1 volt by turning the oscillator slug counterclockwise (i.e. so the slug comes up at you towards the top of the UX-3 case). This backing-off procedure is essential to insure the oscillator is run slightly *below* peak output, which improves the start-stop-start stability (i.e. ability to fire each time turned on) of the unit.

Alignment — Third Step

In theory, if you are completely aligning a unit, you should probably align the multiplier output stage next. We'll come back to that shortly, however.

The alignment of the UHF preselector head is tricky without the proper test equipment. Being a passive bandpass filter, what you are really doing is insuring that the passband of the preselector is as narrow as practical, without creating undue amounts of signal loss. Remember that *any* thru-loss in this preselector contributes to the overall "noise figure" of the converter and grainy looking pictures.

Blonder-Tongue (at the factory) utilizes a CATV matchbox *similar to* that shown on pages 38-40 of the March (1976) CATJ. Only we can*not* say from experience that *our* CATJ published unit *is adequate* for UHF work, we *suspect* it is *not*. The assumption is that you have a "match box" to read the VSWR or input circuit match to J201, the antenna input connector. By tuning the preselector adjustments for *best* match for the input channel of interest, you just naturally *should* have maximum efficiency from the preselector filter. And maximum efficiency means lowest signal loss.

If you have access to a UHF sweep source, you could *perhaps* align the preselector by tying the UHF sweep source to J201, and then using the test jig shown in diagram 6 here to tap into the circuit on the UHF end of X101 (the mixer diode); after removing the mixer diode from the circuit. Standard sweep alignment procedures would apply, but the test jig would have to be very carefully constructed since the alligator clip construction is at best *bad* at UHF (i.e. the clip leads tend to create a non-true set of loading effects on the output of the preselector).

Blonder Tongue recommends using a length of RG-59/U cable between the match box and the input to the UHF preselector. The purpose of the cable is to "deaden" any standing wave effects caused by the connecting link of cable itself (i.e. the cable is long enough that any VSWR created by the mis-tuning of the preselector is not enhanced or diminished (i.e. modified incorrectly) by the connecting link of

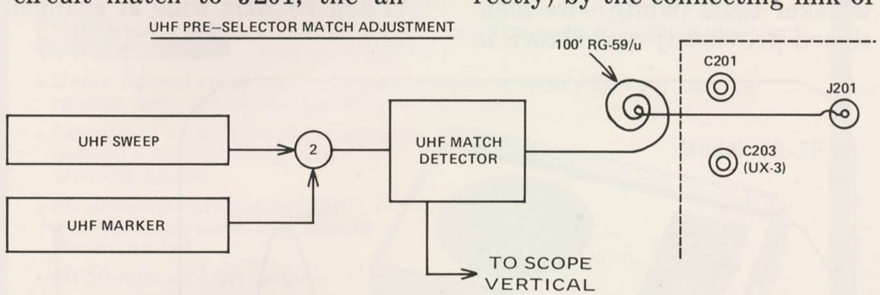


DIAGRAM 10

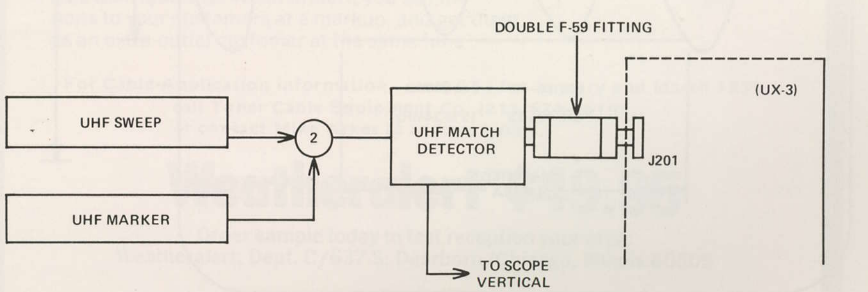


DIAGRAM 10A

cable. Another approach (diagram 10-A) is to use a double type F fitting and mount the CATV matchbox directly to the UHF input on the UX-3 chassis. There is some danger with this also, however.

The common garden variety double fittings tend to be capacitive and somewhat lossy at UHF. Beyond 300 MHz, they start to *have* a loading effect of their own on the circuit they are part of, and it is possible to "warp" the display (mainly through attenuation) by using them. The long and short of all of this is *that at UHF* our standard test procedures are not so good and usual clip leads and bench connections are *not* adequate for accurate work.

Using the B-T 100-feet-of-59/U approach (diagram 10) and a matchbox that is proven to be good at UHF:

(1) Make sure the mixer diode (X101) is in place in the socket (*it* is the resistive load on the preselector);

(2) Adjust C201 and C203 (diagram 10) to get the matched segment of the UHF band into (i.e. centered around) the input channel of interest;

(3) Adjust coupling loops L201 (*end* of wire connecting J201), L204 (*end* of wire lead on 3.9 pF coupling capacitor) and whisker C202 (white wire mentioned previously and shown in photo; between C201 and C203) for proper bandwidth of preselector (see diagram 11).

(4) Re-adjustment on C201 and C203 will be necessary to keep tuning centered on channel desired.

On your display scope, a display linearity of 1 (assign your own vertical scale value to 1) to 3.5 (which is 350% of the value of what you selected for 1) is the proper matched-point for the preselector. *If you can do better than this*, more power to you. (A higher ratio is better; 3.5 to 1 is factory spec).

On this preselector BPF, the whisker (C202) is probably the most critical element in the bandpass *width* adjustment series. Coupling between C201 and C203 is a happy trade-off between too much bandpass width (i.e. the front end is *too* broad) and too little bandpass (i.e. the thru-loss of the preselector filter gets *too high* and the noise figure *suffers* as a result.) As shown in diagram 11, the proper ballpark width for the UX-3 is 9-20 MHz for the matched segment for channels 14-48 and 15-24 MHz for the range channels 49-83. The narrower widths *always come* at the lower frequency portion of each range (i.e. 9 MHz wide at channel 14 and 15 MHz wide at channel 49).

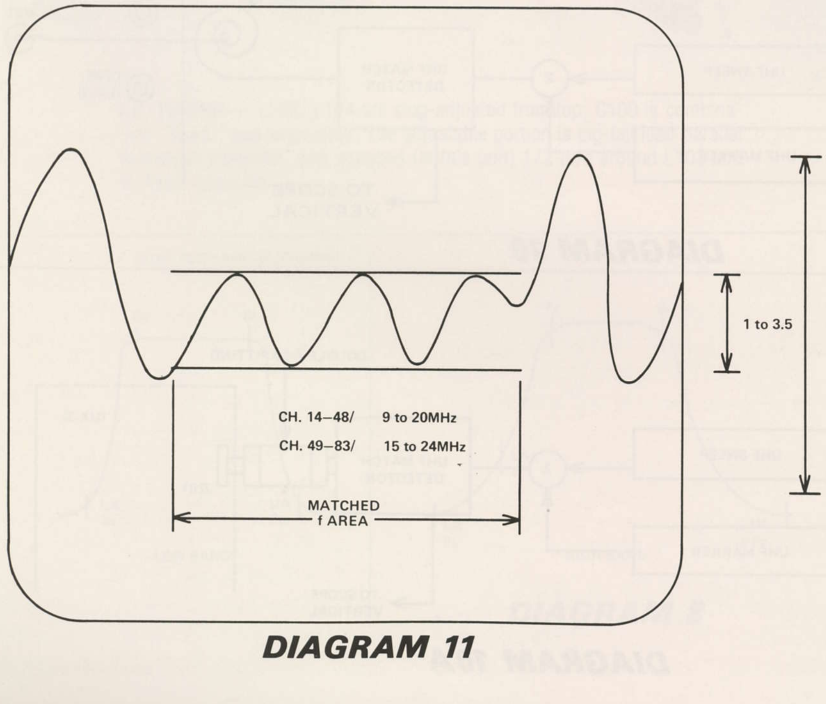


DIAGRAM 11

Alignment – Fourth Step

At this point we have an operating local oscillator, on the fundamental (crystal) frequency, an operating i.f. post amplifier and an operating UHF head. The next step is to get the LO signal to mixer diode X101 to allow it to "beat" against the incoming UHF signal, and produce an output through L205 (diagram 2) on the proper i.f. (VHF) channel.

Most of the UX-3 converters in use have a tuned output stage called a "multiplier output". This is, as noted previously, nothing more than a bandpass filter that is designed to pass *only* the *desired* harmonic multiple of the local oscillator. In our example given previously to make channel 14 come out on 7, we need a 296.0 MHz signal at one end of the mixer diode to mix *in the diode* with the 471.25 MHz channel 14 visual carrier frequency.

In diagram 2 we see a set of tuned circuits called (appropriately) "multiplier output". See diagram12.

(1) Place a VTVM minus (ground) lead at chassis ground and the plus (positive) lead to test point F;

(2) Starting with C403, adjust for a peak VTVM indicated voltage (positive). Then adjust C401 for a maximum peak voltage as well.

(3) Adjust L404/L402 coupling (L404 is *another* wire gimmick that loops over the *top* of L402; L404 ties to one end of X101, the mixer diode, and is reached *through* the cutout hole on the plate sealing up the multiplier compartment) so that the VTVM reads between .02 and .10 volts DC (positive).

If you have a spectrum analyzer, you should be able to place a test-probe lead (diagram 9) over the hole on the bottom of the *multiplier* can bottom plate, or adjacent to the multiplier side of mixer diode X101 and "see" a 296.0 MHz (or whatever) injection signal at this point. Of all of the RF signals you are *likely* to see at this point, the *proper*-frequency injection signal should be far and away *the strongest* of all signals present. That is, if the

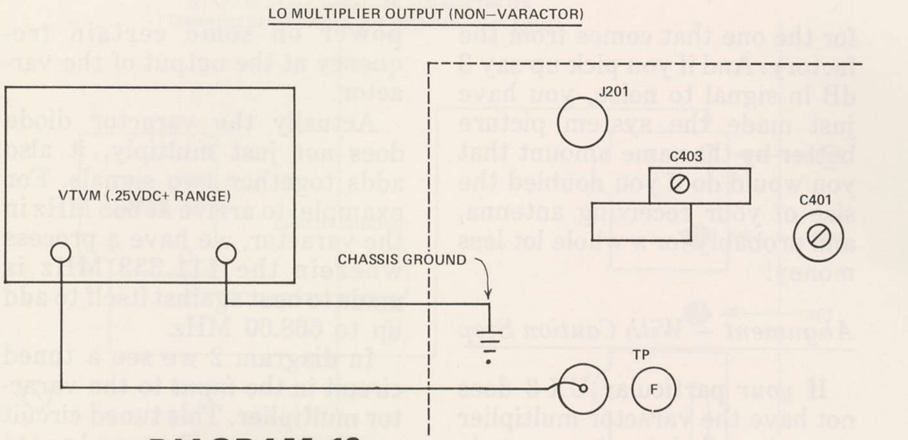


DIAGRAM 12

multiplier output has been *properly adjusted*, there should be no other harmonics (or the fundamental crystal oscillator frequency signal) within 20-30 dB in level of the *selected* injection frequency. If this is *not* true, the multiplier output is tuned to an "image" and you should go back and start over again.

The amount of L0 injection voltage read by the VTVM is a composite of *all* frequencies present. It is therefore *possible* to have the *proper amount* of *total* voltage, but the voltage is on the *wrong* frequency (or frequencies). Exercise care. Now the *noise figure* of the diode (i.e. the efficiency of the diode as a mixer, which is really a measurement of how much signal *loss* there is in the conversion process in the mixer diode) depends *largely* upon (1) *match* to the diode at the UHF input end or side, (2) the *amount* of injection voltage from the L0 end (0.02 minimum to 0.1 volt maximum) and (3) the *current* the diode is allowed to draw. Of these three noise-figure determining criteria, the current drawn by the diode is of major interest.

In diagram 2, if you follow out of the mixer diode down (the page) through L205 through C205 (a feed thru capacitor) to the input to the i.f. amplifier, you will notice test point F. Test point F has an RF choke (L101) and below it a 270 ohm resistor. *This resistor* creates a resistance path to ground for the diode, and *the value* of this resistor determines the current drawn by the mixer diode. You can, *as an experiment*, short the 270 ohm resistor out to ground *with an RF choke* (not directly to ground) and the gain (i.e. the loss of the mixer diode) will go *up* by 1 or 2 dB. This *is* more signal voltage, but it is *also* more noise voltage. That probably seems contradictory, but that is as far as we are going at this point with the lesson.

Except to note that for any *particular* diode (i.e. if you had a handful of mixer diodes, and you drew one out for use in the UX-3) there is an *optimized* (1) match condition at the output of the diode (on the UHF preselector end *and* the L0 multiplier end), (2) L0 injection (go back to L404/L402 steps for varying the L0 voltage) and (3) the current drawn by the diode, for, best noise figure and optimum conversion gain (i.e. loss) of that par-

ticular diode. *No two diodes are alike.*

If you lift the ground end of the 270 ohm resistor and insert a millimeter in series with the resesitor to ground, you could read the current drawn by the diode. Now if you put a 1K small carbon pot in place of the 270 ohm resistor, you can vary the value of the mixer diode load resistor, monitor the current drawn by the diode, and vary the L0 injection voltage between 0.02 and 0.1 volts while simultaneously watching the appearance of the picture being converted from UHF to VHF by the converter. At *some* balance of L0 injection voltage *and* diode current, you will have an optimized (*for that diode*) balance.

This may or may not be where there is minimized diode conversion "loss". And you may also have to mess with L204 (output link in the preselector) for best match *to the diode* to get everything in balance.

When you find optimized operating conditions or parameters for the diode, you can leave the pot in place, as a substitute for the fixed 270 ohm resistor that comes with the unit from B-T, or you can disconnect the pot and use a VOM to measure the resistance at that setting and replace the 270 ohm value with a new value that is as close as possible to the pot setting when the diode was optimized.

Or you can do *none of this* if you are happy with the performance with the 270 ohm resistor in place and some value of injection of L0 to the mixer diode, between 0.02 and 0.1 volts.

The point is that *there is worthwhile signal improvement to be had*, perhaps as much as 3-4 dB in signal to noise, if you take the care (and time) to optimize the diode. And if you have a real fettish for optimized performance (and a really low level UHF input that needs *all* of the help it can get), you can try a selection of mixer diodes. Experience is that there are good ones, fair ones and on occasion poor ones and even a great one or two. *If* you are lucky, you *will find* a better mixer diode to substitute for the one that comes from the factory. And if you pick up say 3 dB in signal to noise, you have just made the system picture better by the same amount that you would do if you doubled the size of your receiving antenna, and probably for a whole lot less money!

Alignment — With Caution Step

If *your* particular UX-3 does not have the varactor multiplier stage installed (again, *most* do *not*, this is reserved for very high UHF channel conversions), you are done with the alignment procedure.

If you have the varactor multiplier (see diagrams 1, 2 and 5), you actually need to add this step back in *after* tune up of the crystal oscillator, and *ahead* of tune up of the multiplier output stage.

The varactor multiplier uses another of those clever diodes. It takes its drive from the crystal oscillator and it produces higher frequency harmonics than the crystal oscillator is typically capable of producing. For example, you need to put channel 76 on channel 7. The visual carrier frequency of channel 76 is 843.25 MHz and the visual carrier frequency of channel 7 is 175.25. The difference frequency is 843.25 minus 175.25 or 668.00 MHz. Thus the L0 injection coming into the mixer diode from the tuned output of the multiplier is 668.00 MHz. In this case B-T uses a 111.333 MHz crystal. Thus we are 1/6th of 668.00 MHz with the crystal oscillator. Even as rich as the crystal oscillator is in harmonic output content, there is *not* sufficient 6th harmonic energy (111.333 x 6) available so that after the tuned multiplier output we would have sufficient L0 injection to get to the 0.02 to 0.1 volt injection voltage required.

The varactor takes care of that nicely, by "multiplying" the 111.333 MHz signal up to the desired 668.00 MHz. The varactor is a diode, and it has frequency-multiplication efficiencies as high as 75% when operated properly. This means that you can get up to 75% of the input power on some certain frequency at the output of the varactor.

Actually the varactor diode does *not* just multiply, it also adds together two signals. For example, to arrive at 668 MHz in the varactor, we have a process wherein the 111.333 MHz is made to beat against itself to add up to 668.00 MHz.

In diagram 2 we see a tuned circuit in the *input* to the varactor multiplier. This tuned circuit can (for example) be tuned *not* to 111.333 MHz but the second harmonic of 111.333 or 222.666 MHz. This is in effect a tuned bandpass filter that allows thru only the second harmonic energy (222.666) of the crystal oscillator. This energy is presented to the anode end of X501 (the varactor diode) and the varactor generates a harmonic of the applied 222.666 MHz signal, on 2X 222.666 or 445.332 MHz. Now we have 222.666 *plus* 445.332 MHz available *at the input to the tuned output side of the varactor multiplier* (L503, C507). If we tune this L503/C507 circuit to 668.00 MHz, the *sum of* 222.666 *and* 445.332 are passed through by the L503/C507 tuned circuit and viola...we have a 668.00 MHz signal! The diode family of devices are really pretty nifty.

(1) Connect the VTVM with the minus lead to chassis ground and the plus lead to test point E (see diagram 13). Start with C503 and C501 fully out (i.e. back upwards counterclockwise).

(2) Starting with C503, adjust for peak negative voltage. Now adjust C501 for peak negative voltage. And go back and readjust both again. And again.

(3) Now move the plus lead of the VTVM to test point F and align the multiplier output section. Adjust trimmer C403 (diagram 12) for peak positive voltage.

(4) Adjust C401 for peak positive voltage, go back and repeak C403 and C401. Now adjust C507 (diagram 13B) for maximum (peak) voltage.

It is advisable to go ahead and check (if you are able) with a spectrum analyzer for *proper* signal frequency at the *output* of

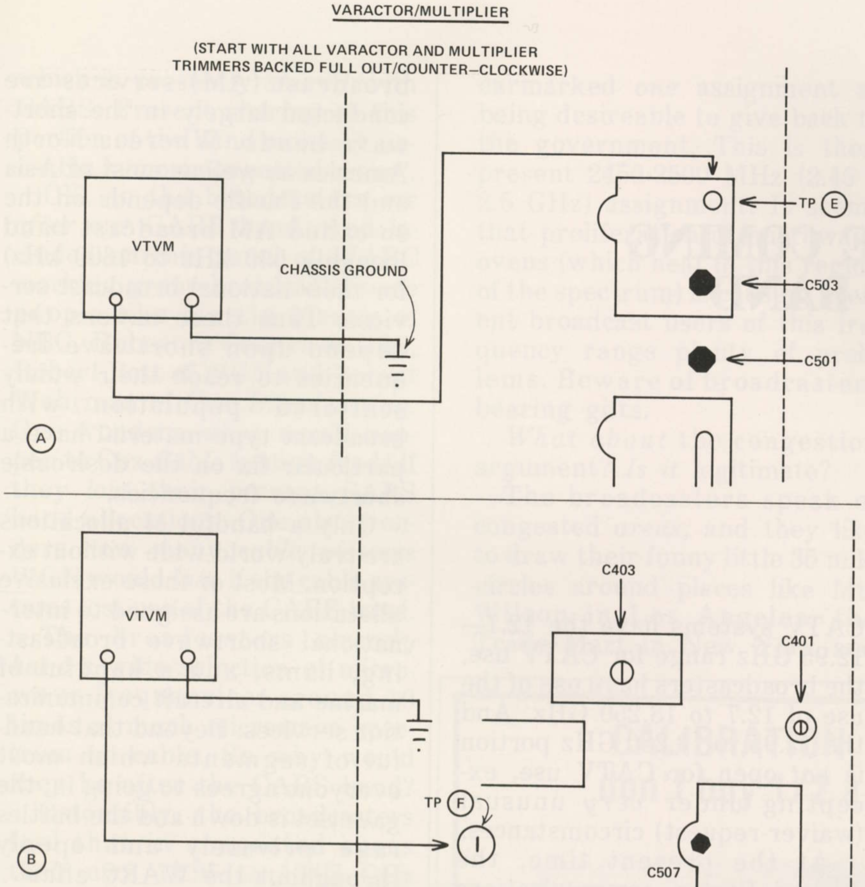


DIAGRAM 13

the L0 chain (i.e. at the input to the mixer diode, or using a probe at the hole in the bottom of the multiplier output tuned circuit). If you do not have a spectrum analyzer handy that tunes through the UHF TV band (which is where the L0 injection frequency will be at the input to the mixer diode), *very* loosely couple a probe to the hole at the output of the tuned multiplier output and connect it to the UHF terminals on a standard TV receiver. You should be able to tune to the TV channel where the L0 (i.e. 668 MHz or channel 46/47 in our example) falls and see a CW carrier (i.e. blank non-modulated signal). If you have *lots* of signal *all over* the UHF band as you tune, decouple the probe even more. Too much L0 into the UHF tuner will cause the tuner to cross modulate and create images in the tuner. The images *may* be *real* spurious signals out of the L0 (in which case you've got problems) *or* they could just be TV tuner overload. Tune the TV receiver to the calculated channel where the L0 *should* fall, then adjust the probe so that you *just begin to see* a carrier present on the TV receiver. At this point you should be able to tune the UHF tuner on the TV receiver *through the range* 14 to 83 and find *no other* CW carrier present. In other words, if the *strongest* carrier you find is one the TV channel where you calculate the L0 *should* fall, and you find no other potent signals as you tune through the UHF band, the chances are pretty good you have your varactor tuned sections and the multiplier tuned output properly set on the proper multiples or harmonics.

Summary

There is one other UHF converter subject which we have not touched on at this time; we are saving forbidden conversions for a later report now in preparation. Suffice to say that forbidden conversions are UHF to VHF or (VHF to VHF) conversions where to get from the input to the output channel, the L0 frequency required just happens to fall in or very close to the i.f. (VHF) output frequency. Obviously two signals cannot occupy the same spectrum at the same time, without there being interference between the two. But more about that another time!

CHANGES ARE COMING FOR CARS BAND

Winds Of Change

The rules and regulations governing CATV microwave service have gone on with few changes during the past several years, largely taking a back seat to the solidification and revamping of the *Part 76* rules and regulations originally announced in March of 1972. But times *are* changing, and CARS band rules are presently under some minor and major revisions at the FCC.

In recent years the growth of CARS band frequency usage has been slow, not spectacular, but steady. Immediately following the adoption in 1972 of the Part 76 rules, there was a sudden (not unexpected) influx of CARS band applications from CATV (and would-be CATV) operators who envisioned heavy usage of the 12.700 / 12.950 GHz band. The frequency range, known as CARS Band (for Cable Television Relay Service), is on a *shared* basis with television broadcast station usage, with TV station usage broadly including studio-transmitter linking, and intercity relaying. However, at the *present* time the TV stations may *not* be licensed for the 12.7 / 12.95 GHz region for a particular area or location *if* their proposed installation will create *interference* to *any existing* CARS band licensee. Similarly, if the TV station usage is established *first*, any *later* CATV use is conditioned on CATV's not causing interference to the TV station usage. If this seems like a fair arrangement, it should be noted while CATV systems have the 12.7—12.95 GHz range for CATV use, the broadcasters have use of the use of 12.7 *to* 13.250 GHz. And the 12.95 to 13.250 GHz portion is *not* open for CATV use, excepting under *very* unusual (waiver-request) circumstances.

At the present time, the United States communications industry is preparing for something called "WARC-79" which stands for World Administrative Radio Conference, 1979 version. A WARC meeting is when all of the communication-using nations of the world get together (every 5 to 10 years) and decide what changes are required in the world's communication's spectrum. In past WARC get-togethers, the present international communications spectrum has been formulated. Each time there is a new WARC get-together, somebody wins and somebody loses. Prior to any WARC affair, every country in the world attempts to formulate *their* own "position" regarding every bit of spectrum from DC to daylight, or 10 kHz to someplace around 300 GHz as things now stand. The concept is that once the *national* position is formulated, all of the nations of the world, meeting in a mini-U.N. type of format, then decide how to reach a majority accord for a set of *world-wide* allocations.

Different nations have different objectives, of course. For example, in Africa, Europe and much of Central and South America, many of the national broadcast (AM) services are conducted largely in the shortwave bands. Whereas North America as well as most of Asia and the Pacific depends on the so-called AM broadcast band (roughly 530 kHz to 1600 kHz) for *their* national broadcast services. Thus these nations that depend upon shortwave frequencies to reach their widely scattered population with broadcast type material have a particular fix on the desireable shortwave frequencies.

Only a handful of allocations are truly world-wide without exception. Most of these exclusive allocations are assigned to international shortwave broadcasting, hams, and a handful of marine and aircraft communication services. Beyond that handful of segments which most everyone agrees to going in, the gauntlet is down and the battles rage privately and openly throughout the WARC affair.

In preparing for WARC-79, virtually every U.S. user of the spectrum is attempting to get its own house in order so as to be able to present to the U.S. WARC representatives their game plan for their portions of the spectrum. The broadcasters, like all other influential and well-heeled spectrum users, are planning to ask for *an expansion* of several of their present U.S. assignments. One interests us here.

Close inspection of the minutes of the March 9th meeting of the Broadcast Auxiliary Service Working Group (i.e. the broadcasters working on their portion of the WARC preparations) reveals that the broadcasters *are preparing to pressure* the U.S. representatives to WARC with a strong request that the present shared arrangement in the 12.7 to 13.25 GHz band end. The broadcasters, again, have virtually *private* use of the 12.95—13.25 GHz portion of this spectrum, and *secondary* usage of the lower portion or 12.7 to 12.95 GHz. The broadcasters' March 9th meeting concluded with the notation that "(we are requesting) *exclusive use* of the lower half (of 12.7—13.25 GHz),

which is presently *shared* with CARS. Present sharing of this portion of the band makes it unusable in most congested areas".

OK, so the broadcasters *are after* our CARS band. And included on this panel of WARC working group-broadcasters are people like Martin Meany of NBC, Robert O'Conner of CBS, Robert Batt of WGN and Robert Wehrman of Cox *Broadcasting.* One wonders what would happen to Cox *Cable* system feeds if they *lost* their present CARS band allocations. One also wonders how many *cable viewers* WGN would *lose* if the cable systems lost use of the CARS band.

The broadcasters *already have* a wide selection of microwave frequencies; around 10 times as much microwave spectrum as cable. So why would they be after the CARS band?

Ostensibly, the broadcasters feel that in congested areas their own 12.95 to 13.25 GHz portion of the spectrum is used up; and alternately, they *claim* they are finding the 12.7 to 12.95 GHz portion "congested" with CARS users. What is causing such heavy broadcaster use of the 12.7—13.25 GHz region? *ENG for one thing.* ENG stands for electronic news gathering, and it involves all of those cute little mini-cam cameras and their attached microwave transmitters which the broadcasters are standing in line to purchase. The ENG concept usually involves a low power transportable (or back carried) 13 GHz region microwave transmitter. The camera feed typically is sent a few blocks to a mobile van *in the 13 GHz region,* and then the van relays the signal to the broadcast studios via a lower frequency broadcast assignment (such as in the 2 or 7 GHz region). With hundreds of ENG cameras in use and hundreds more back ordered, the broadcasters are using *this* excuse to get the attention of the FCC through the WARC working group.

The broadcasters cannot be simply stamped as "greedy". Of all of their many present microwave assignments, they *have* earmarked *one* assignment as being desireable to give back to the government. This is their present 2450-2500 MHz (2.45 / 2.5 GHz) assignment. It seems that proliferation of microwave ovens (which heat in this region of the spectrum) is causing present broadcast users of this frequency range plenty of problems. Beware of broadcasters bearing gifts.

What about the congestion argument? *Is it* legitimate?

The broadcasters speak of congested *areas*, and they like to draw their funny little 35 mile circles around places like Mt. Wilson in Los Angeles, the Trade Mart in New York and the post office in San Antonio. They presently list around 15 such congested regions in their working sheets. But a cross check of these "congested areas" reveals some strange *facts.* For example, San Antonio (which is on the broadcaster list) has *no* CARS band activity, period, within 35 miles of their circle center. Los Angeles *as an area* does have considerable CARS band "traffic", but certainly not to the point that the *whole 35 mile zone* is saturated. In fact, and the broadcasters are plenty clever with this one, the only real congestion is at one or two *points within the circle.* One of the *points* where there is con-

gestion is at Mt. Wilson, where a dozen TV transmitters feed links up and down 18-20 hours a day. But *this* is a *point* of congestion, not a zone of congestion. And that makes a big difference. Because of the descrete point to descrete point nature of CARS band frequencies, in an area 70 miles across centered on Mt. Wilson dozens of transmitter/receiver packages can operate without interference on the *same* CARS band channel. The broadcasters would *like you to forget* this fact and look at the congestion *only at Mt. Wilson* or in the Burbank area where the network studios are located; and after summing *these two* points *assume* that the whole area is congested. The broadcasters get an "A" for trying.

CARS band users are restricted to the 12.7 to 12.95 GHz region, *unless* they can show that they simply have no room there (do to prior usage) and then *if* there is spectrum available in the sacred broadcaster region from 12.95 to 13.25 GHz, the cable operator may get permission (a waiver) from the Commission to operate there. This infuriates the broadcasters and they have fought any such applications tooth and toenail. CATV has won this skirmish only twice; once in far south Texas in a rural area, and again in California.

In the south Texas situation, the CARS band user wished to carry through a repeater five TV broadcast signals. There are 250 MHz of CARS band space, and that divides into 10 channels 25 MHz wide each (for FM). If you transmit from point "1" to point "2" on the so-called Group "A" channels, and then wish to repeat from "2" to "3" on the so-called Group "B" channels, you run smack dab into utilizing alternate (adjacent) channels "in and out". This is tricky at best, usually not even plausible. Upon an appropriate showing, the south Texas CATV operator received permission to move into the sacred broadcaster region for his "2" to "3" link. He probably got permission because the south Texas area had very little (read none) broadcast use of the spectrum.

In the California situation, the cable operator had a novel duplex situation. He wanted to go to his headend from his office-studio, and then from the headend back out again via normal CARS band service *along with* his regular off-air relayed signals; with as much spectrum from his uplink channel to his outlink channel as possible to allow the system to operate in realtime duplex. He won, but only after considerable broadcaster efforts to shut him off at the FCC. There are two additional waiver requests pending (i.e. CATV wishing to use part of the broadcaster's region); both have drawn substantial broadcast opposition.

In this game of co-sharing and jockeying for position, the Commission still has outstanding a June 1973 petition filed by the TelePrompTer Corporation, in which TPT requested the FCC to allow *full-band co-sharing* between CATV and broadcast. TPT asked that the CARS allocation be *expanded* to 12.7—13.25 GHz. Were such a petition adopted it would not relieve any new applicant from proving that his *new* installation would *not* cause interference with any prior user. But it would relieve the present "waiver bottleneck" which any CATV user must run around or through when he wants into the broadcaster's portion of the service. Waivers cost money, take extra time, and there is no guarantee that your lobby/attorney can out-lobby or out manuever the broadcaster's attorney.

The TPT plan was *perhaps* premature. Or perhaps it was *too* timely. At the time it was filed, CARS band was in the midst of a CP (construction permit) explosion. For around one year after the 1972 CATV rules came out, the Commission received a very large number of CARS band applications. TPT studied where these applications were and decided there was or would soon be congestion *if* everyone got stuck into the 12.7—12.95 GHz portion. The FCC, acting with casual slowness, waited awhile after TPT filed its Petition For Rule-making and then *they took a look* not at the CP influx, but rather at the CP's which actually turned into operating licensees. What the Commission found, in 1974, was that a very high percentage of the CP's never got on the air. Such a high percentage that, *at the time*, there seemed no real justification for the CATV Bureau to run head on into the broadcast bureau and fight it out for more CATV frequencies in the 13 GHz band.

So the TPT Petition has laid around gathering dust.

Recently the CARS band arm of the Cable Bureau dusted it off, and took a new look. First of all, it found that while the CP's granted in large quantities in the 72-74 era were still largely not operational, there has been a gradual and continued growth of CARS band use. The handful of waivers sought to date, including the two actually won by CATV companies, suggests to the Cable Bureau that perhaps the time is coming for a new run with the TPT plan, or one similar.

All of this comes at a time when the broadcasters are rallying their own troops to prepare for an all-out attack (via the WARC study group) on the whole CARS band allocation of 12.7 to 12.95 GHz. Both sides will obviously come out slugging, and this summer seems to be a likely time for the bell to ring on round one.

One of the key issues will be the broadcaster's proliferation of ENG gear. The ENG 13 GHz microwave is basically low power and very mobile. Because ENG usage is impossible to predict, an ENG unit may show up anyplace at anytime to cover a hot news story. There is virtually no CARS band experience with mobile transmitter sources. *At best*, according to Commission records, CATV users of the 12.7 to 12.95 GHz region *may* have six mobile packages in use. And if these have been creating (or receiv-

ing) interference, nobody seems to know much about it. *Clearly, more information is needed.* But the general feeling at the Cable Bureau is that if broadcasters get into the 12.7 to 12.95 GHz band under co-sharing or waivers, *some* CARS band installations are going to experience *some* interference *some* of the time. Such are the odds of the game.

There is every likelihood that the whole future of the 12.7—13.25 GHz region, WARC-79 or not, will be a *long*, involved power play. Most people believe that it may take a couple of years to resolve, and, in the interim, it is unlikely that anyone will get any waivers to co-share either side of the other side's spectrum. At least not in the so-called congested areas of the country.

Editorial Changes

Not all CARS band rules will be frozen until the new battle is over. A couple of so-called editorial changes are in the wind now, and may actually get FCC approval before the summer is over.

(1) *Measurement Intervals* — At the present time section 78.113 requires "every system maintain suitable means to insure that the operating frequency is held to within the prescribed tolerances (0.02%) at all times" with measurements to be made *no less often than once per month.*

The once-per-month measurement interval rubs a lot of CATV operators the wrong way. Virtually every other point-to-point service allows this measurement to be made on an *annual* basis. And that includes broadcast services. Nobody seems to know why or how CARS band licensees ended up with 12 measurements for every one which a broadcaster has to make, except that it raises the cost of CATV doing business and therefore it would be desireable to "slip in" *if* you were anti-CATV.

So this summer, perhaps by mid-July, an "editorial change" is being made in the rules to allow these frequency measurements to be made once per year, just like everyone else in the microwave business.

There is some confusion as to who can make the measurements. The rules have as a genesis the language found in the Private Operational Fixed (microwave) Service, Part 94. And Part 94.103 states that "all transmitter *adjustments* for tests or during regular operation, servicing or maintenance shall be made by or under the *immediate* supervision of a person holding a First or Second Class Radiotelephone license, who shall be responsible for proper function of the station equipment".

Broadly interpreted, making a frequency measurement is considered a form of testing, and immediate supervision means that the First or Second Class person is actually *on the premise* and standing by while the test/frequency measurements are made. Thus a CARS band operator has *no* choice but to engage the services of someone *with* the proper class of license for his tests. Until the rules are actually changed, this amounts to having such a "warm body" on premises at least once every month.

This is of course not always possible. Which leads by a circuitous route to another problem area which the FCC's Field Office Bureau (the field engineers and inspectors) reports it has run into all together too often.

Paragraph 78.55 (a) states that a CARS band relay station is limited (except for brief test periods) to radiation of a signal to the period when the broadcast station it is relaying is *on the air*. In other words, the CARS band transmitter is to be equipped with some form of carrier-operated switching network that turns the CARS band transmitter on when the broadcast day begins, and turns the CARS band transmit gear off at the end of the broadcast day. So far so good.

But, paragraph 78.69 (a) (1)

states that the operator of any CARS band station shall maintain a *log* of the operation of the CARS band facility, noting in "clear and legible writing" the *exact* time when the CARS band transmitter goes on, and when it goes off. Plus, if there are any interruptions in the CARS band transmitter operation (i.e. when the incoming signal is present, or if it fades in the middle of a broadcast day), this also must be noted right along with (78.69 [a] [2]) an "explanation of the cause of the failure and the duration of the off-air period".

The FOB people have reported to the Commission that *they are finding* a large quantity of CATV operators who are *not* maintaining this "log". Just how this will be dealt with in the editorial re-write period (if at all) is unknown at this time. But one is forced to ask "*why is any of this necessary?*". If there is an editorial change, it will probably be limited to unattended CARS band transmitters.

(2) *Restructuring Allocations* — There is one other editorial change in the wind. And it relates to the so-called Group "C" and "D" channel-blocks which are largely (if not exclusively) put to use by customers of Theta Com, and the AML package.

At the present time, most of the AML users are transporting the 20 MHz wide FM broadcast band by using a 20 MHz 12.7 GHz segment. This corresponds to four AML-type channels including the 6 MHz channels plus the first 2 MHz of a fourth channel. Thus the balance of the fourth channel goes unused. By editorial change, the AML allocations will be restructured to correspond more closely to the actual use by the industry. The same example would hold for the "D" channels as well.

Summary

If you are a user of the CARS band, or hold a CP for future use of the CARS band (CP's run out in one year after being granted, so if you got one once but never constructed the station, recheck your date of authorization; it may have run out!), you have a stake in what is happenig to *your band* in Washington.

If your firm regularly utilizes a Washington attorney to handle your CARS band matters, perhaps you should have a talk with this fellow and ask him to check into how the minor and major changes in the wind might affect your operation.

It may well be that the CARS band scene is due for some major changes. It may also well be that CARS band users, to protect their present investments, should investigate setting up some form of cooperative industry committee to construct an industry wide position for future FCC activities in this area. The opposition is well organized and well funded. Need we say more?

THE MARGIN OF CATV (Sometimes It's Not Much!)

Thin — Continued

In the May issue of CATJ the often "thin margin" between the CATV delivered signal and the home viewer antenna was explored with emphasis on establishing a clean(er) signal to noise ratio and clean(er) signal to interference ratios.

Signals are where you find them. Very few people *really* have the *background* to be classified as "experts" in signal location. There are experts in "knife edge" locating, and there are experts at "duct location" but there are few (if indeed any) true experts in *all* phases of abnormal VHF-UHF propagation.

This month's treatment of the "thin margin" will largely be devoted to some of the observed peculiarities which we have come across in doing research for this series. A good many of the situations to follow, as examples or illustrations of "abnormal wave propagation" have come to us via many sources *other than* CATV circles. But the lessons here are of utility to our CATV service simple *because they illustrate* profoundly that signals *are indeed where you find them.*

In our research for abnormal propagation examples to illustrate our point we have largely discarded unsubstantiated reports, or those which seem to occur *only for brief periods* of time. Anyone who has spent any number of years in CATV knows full well that on any given night (or morning, or afternoon, etc.) you can pick up virtually any distant signal you wish. But the "fleeting reception" (often termed DX reception, which is Ham radio lingo for long haul stuff) has very little or no practical "sales value" to our primary concern, which is of course providing our customers with *reliable reception* a very high percentage of the time, as close to 100% of the time as our equipment and skills will allow.

One of our favorite stories (it is a story in the narrative form only, for it is the gospel truth) involves a fellow cable operator in south Texas who was engaged for a reasonably handsome sum of money to bring television to Ciudad del Carmen in Campeche, bordering on the northern Gulf of Mexico along Mexico's Yucatan peninsula. If you drag out a Rand-McNally Atlas and study the coast line of Mexico you will notice Ciudad del Carmen sits approximately half way between Veracruz in the state of Veracruz and Merida in the state of Yucatan. The Texas fellow had been asked to come to Ciudad del Carmen to survey the possibilities of bringing two television channels to Ciudad del Carmen. Although there were a couple of closer stations, two 10,000 foot high transmitters on channels 8 and 10 located at Las Lajas, Veracruz *seemed* the best bet. The Texan knew from prior sorties into Mexico that along the Bay of Campeche, working east from the state of Veracruz, that the 10,000 foot high (325 kW) transmitters at Las Lajas "seemed to go forever". Located close to the Gulf, the *horizon* from the 10,000 foot transmitter sites is in the neighborhood of 220 miles away. Ciudad del Carmen is around 340 miles. But the sharp Texan who had pioneered television in several parts of southwest Texas knew that there should be an "inversion layer" laying over the Bay of Campeche, for several hundred miles, *a high percentage of the time.*

At Ciudad del Carmen with portable ten element yagi antennas and some field strenth meters, he went probing at various sites along the Bay. He found several locations where 50-100 microvolts of signal seemed quite steady, although he was 340 miles from the transmitter. Then he went back to Texas to plan "the receiving system".

Some months later he returned with a private plane loaded down with headend gear. After several days of hanging antennas on a convenient water tower and running down-leads and setting in low noise preamplifiers, the big moment finally arrived. The field strength meter indicated there was around + 15 dBmV pouring out of the down-lead after preamplification.

During the day the Texan had noticed a weather front moving over the Gulf, one of the "northerners" that sweep down through Texas that time of year and pass on south into the Gulf. The temperature had dropped a few degrees but no rain had come out of it.

Switching to channel 10, he waited for the television receiver to warm up, the first "regular" television residents of Ciudad del Carmen had ever seen. An anxious gathering of local officials were standing around, including all of the town's officials. The CRT lit and and almost flawless picture appeared. The proud Texan reached for the volume control knob just as a local newscast was ending. On came the station ID, and in perfect English the announcer said "CBS for Corpus Christi; KZTV channel 10". Corpus Christi is nearly 700 miles northwest of Ciudad del Carmen.

Sheepishly the Texan turned and faced his hosts. The Mayor of Ciudad del Carmen gazed into the Texan's eyes, and then

turned to his second in command to say in his native tongue . . . "See, I have been telling you all along, you hire a Gringo and he brings you Gringo TV!"

The reception from Corpus Christi *was* very impressive, but the timing was *atrocious*. Of course after a few hours it went away and the desired XHAI at Las Lajas appeared. But it took the Texan several extra days to get paid for his work, because the Ciudad del Carmen officials were not so sure that KZTV was not going to come back at any moment!

Of course it does, every now and again. But for the most part, or better than 90% of the time, the long 340 mile path works and works very well.

Back in September 1971 an article appeared in *Popular Eelctronics* magazine touting a new consumer device called the "All American Sports Amplifier". The "AASA" was a happy blend of an active bandpass filter and a low noise (J-FET) signal preamplifier, and the unit was designed specifically to allow Viking football fans in Minneapolis or Cowboy football fans in Dallas or Redskin football fans in Washington (etc.) to drag in *locally blacked out* Sunday afternoon football games from 80-150 mile distant stations. Because of the large circulation of Popular electronics (over 500,000 at the time) and its world-wide distribution, the author of the AASA piece received a very large volume of mail asking for instructions for using his device in some pretty weird places, many of them *without* conventional television. Two of which were subsequently check out are worth passing along.

On Ascension Island (a small British outpost located halfway between the easternmost tip of Brazil and Lurna in what was *then* Angola in Africa) a group of British communications people employed by the British overseas postal communications sytem had been experimenting with some VHF communications receivers. They had found that television channel 11 located at Recife, Brazil (approximately *1,500 miles to the west* across the South Atlantic ocean) was received virtually consistently for *several months each year*. Curious about the strange wave propagation that provided sign-on to sign-off television reception at 200 MHz over such a long path, they had set out to measure the consistency. They found that during the South Atlantic spring and summer, and far into the fall, the signal level from channel 11 Recife averaged 50 to 100 microvolts on a dipole antenna! Other Recife transmitters, on channels 2 (54-60 MHz) and 6 (82-88 MHz) were also seen, but only on occasion. The group finally developed a class in Portuguese so that they could understand and enjoy the 1,500 mile distant programs!

Almost half way around the world, another P-E reader wrote to ask if the AASA would "improve his reception from FNQ-TV on Australian channel A-10 (209.25 MHz video) and TNQ-TV on Australian channel A-7 (182.25 MHz video). FNQ-TV is located at Cairns, Queensland, Australia at an elevation of around 5,000 feet above sea level. TNQ-TV is located at Townsville, Queensland at an elevation several thousand feet above sea level. The viewer was located on the *side* of Mt. Victoria north of Port Moresby, New Guinea. *The distance to Cairns is around 550 miles and to Townsville around 725 miles*. Like the Recife to Ascension Island "path" and the Las Lajas to Ciudad del Carmen path, this one is also largely overwater. And like the Mexican path, one end is substantially elevated, in fact because of the 5,000 foot elevation on the New Guinea end, *both ends* are substantially elevated. New Guinea had no local television at the time (it may still not if FACTBOOK is accurate). The amazing thing about this path was the almost rock solid signal levels, *and* their considerable strength. On a 10 dB gain yagi antenna, the New Guineau viewer had from 500 to 600 microvolts of signal on *both* channels without preamplification. In one years time, he had experienced only *two days of signal outage*. That is, in cumulative time, probably more reliable than many 100 mile path CATV signals experience in this country!

So there is a set of natural ingredients which when properly combined provide some most unusual long haul, and consistent VHF (and seemingly UHF) signal propagation. One of these ingredients is an overwater path in the tropics, or near to the tropics. There are many places around this globe where high pressure areas just sit day in and day out, month in and month out. Ocean currents and over-water air flow patterns are *exceedling stable*. They mix to create ducting or long-haul signal propagation paths. In some areas of the world this is *seasonal* (i.e. the Gulf of Mexico and across the South Atlantic) while in other areas of the world it is almost totally consistent. During summer months, or June-July-August, for example, commercial airline pilots flying west to Hawaii out of San Francisco airport know that a very high percentage of the time after they clear the busy traffic patterns at San Francisco International and climb to 3-5,000 feet and head out to the southwest they can switch their radios in the 120-140 MHz range to the Honolulu airport channels and talk their way in, even though they are still within eyesight of the San Francisco area coastline *and Hawaii is more than 2,300 miles distant!* A group from Stanford University has located an experimental off-air receiving station on television channel 12 atop the hills behind Palo Alto overlooking the Pacific to the west. With a large stacked array of Yagi-Uda antennas, they monitor for KMVI-TV, channel 12 on Maui. The KMVI transmitter site is atop 10,000 foot Haleakala Crater, and the signal has a good shot in getting into the warm-weather-season "duct" which builds and holds towards the California coast. In several years of monitoring, the Stan-

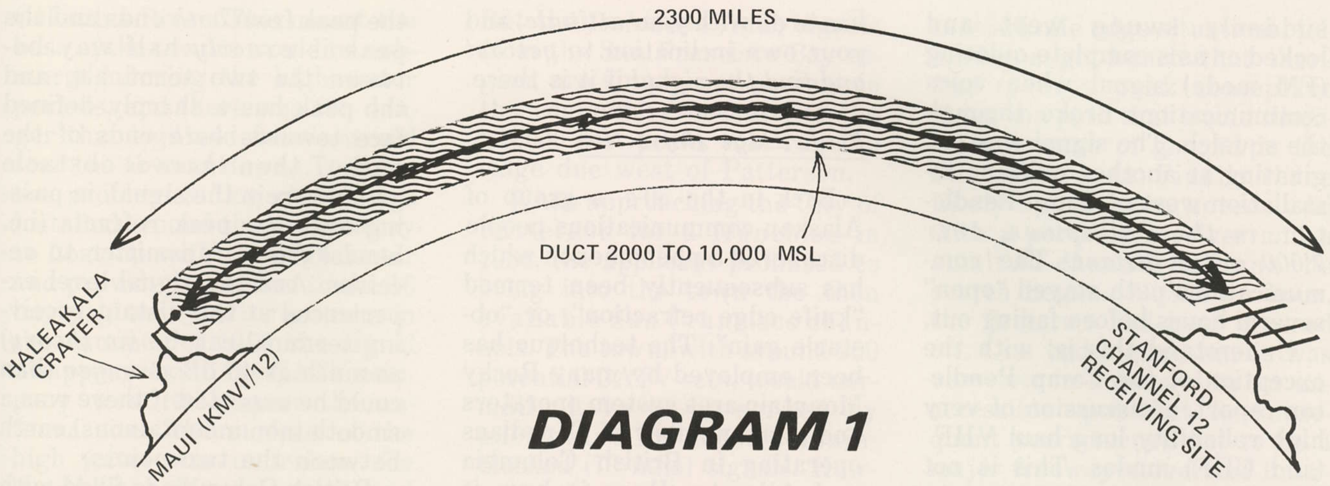


DIAGRAM 1

ford group has found the KMVI transmitter signal amazingly consistent during the later portion of June, through July and into early August. *And this is some 2,300 miles.*

Once again, the primary ingredients are present. A well elevated site at one end, to link-into-the long haul ducting that builds and holds over the water.

Such ducts (see diagram 1 here) are not unlike waveguides. They are frequency sensitive (example: The Ascension Island reception of channel 11 from Recife but the very *infrequent* reception of channel 6 at Recife) and if they tend to "cut off" in some frequency range, it is usually on the *low end* of the frequency range where they quit. Some university studies have found that for all practical purposes, the higher the transmitting (receiving) frequency (i.e. the frequency which "couples into the duct"), the greater the duct's "efficiency" in transporting the coupled signal over long distances. One of the more impressive substantiated reports of this phenomenon involves a Camp Pendleton, California communcations team operating on a point overlooking the Pacific one day in midsummer several years ago (the same period when the ducting is at its peak between California and Hawaii). Operating a *6 GHz range* portable microwave terminal, the small 2 foot dish was in a "search mode" which means it automatically tracked itself for peak signal from any signal that was on channel. In the midst of a field exercise the dish

suddenly swung west and locked on as a complete quieting (FM mode) signal when voice communications broke through the squelch. The signal was originating at another military installation west of Camp Pendleton, *in the Phillipines, over 7,000 miles distant!* The communications path stayed "open" several hours before fading out.

Understand this is, with the exception of the Camp Pendleton report, a discussion of very high reliability long haul VHF (and UHF) modes. This is not your *here now and gone in a minute* "sporadic" stuff which anyone in CATV very long has experienced. This is in the range of the same reliability which you experience on any of your 100-120 mile off-air VHF signals at your present headends.

Yes, these are primarily over-water paths. And yes, many if not most of these are within the general tropics area. Furthermore, it is likely that someone *could* bring Australian television to New Guinea using the duct which seems to hold on that example path, or someone could probably bring Brazilian television clear east to the western coast of Africa. The signals are there...if you know where to look for them and how to capture them. Remember that Ciudad del Carmen gets its television over a ducting path some 340 miles of largely open water, and the Texan *did get paid* for his work (after Corpus Christi faded out!).

So what does all of this have to do with finding signals in your area from that 100 mile distant much-desired UHF indie? It has to do with your *attitude*, and your own inclination to *get out and find the signal* if it is there.

Knife Edge Refraction

Back in the 50's, a group of Alaskan communications people discovered a phenomenon which has subsequently been termed "knife edge refraction", or "obstacle gain". The technique has been employed by many Rocky Mountain area system operators and a fair number of Canadians operating in British Columbia and Alberta. Here is how it works.

It was discovered that a well placed mountain peak (or a sharp ridge), located so that it intercepts the direct path of a VHF (UHF) signal at its approximate mid-way point between transmitter and receiver can *create signal* behind the peak in what would normally be considered a "dead zone" or "shadow area". *Ideally*, the peak should be tall enough to be "seen" from both ends of the path, and equally *ideally*, it should be located so as to be *precisely* half-way between the transmitter and the receiver. See diagram 2.

Such things seldom happen in *real* life. The peak is closer to one end of the path than the other, the peak can be seen (visually) by one end of the path but not the other, the peak is slightly off the path, and so on, is the normal situation.

The difference between the ideal situation and the more normalized situation is one of decibels. If everything is *just right*, that is there is visual siting of the peak from *both* ends and the peak is *exactly* half way between the two terminals, and the peak has a sharply defined face towards *both* ends of the path...then *there is* obstacle gain wherein the signal, in passing over the peak refracts (i.e. bends) from transmitter to receiver. And the signal level experienced at the distant receiving terminal can be (*in theory*) as much as 40 dB *stronger* than could be expected if there was a smooth (non-mountainous) earth between the two points.

British Columbia is filled with CATV headend sites which make use of knife edge refraction. Squamish, British Columbia, began CATV service because a young fellow named Bud Shepard probed around the area looking for signal. He finally found it, in an orchard 15 feet *below* sea level where his antennas ended up pointing directly into the sharp side of a 6,600 foot mountain. Channels 4 and 5 from Seattle and 12 from Bellingham provided three channels of "early cable" to Squamish.

A system installed at Kaslo, British Columbia in early 1958 found the only usable (only period, actually) was an 18 microvolt signal (— 35 dBmV!) on a ten element yagi, located on a thin beach-point jutting out into Lake Kootenay. By building a complex 16 bay yagi array on twin 80 foot towers, the signal was brought up to something *approaching* — 20 dBmV at the antenna. However during the spring and summer the Kootenay Lake level is raised and lowered for flood control of the

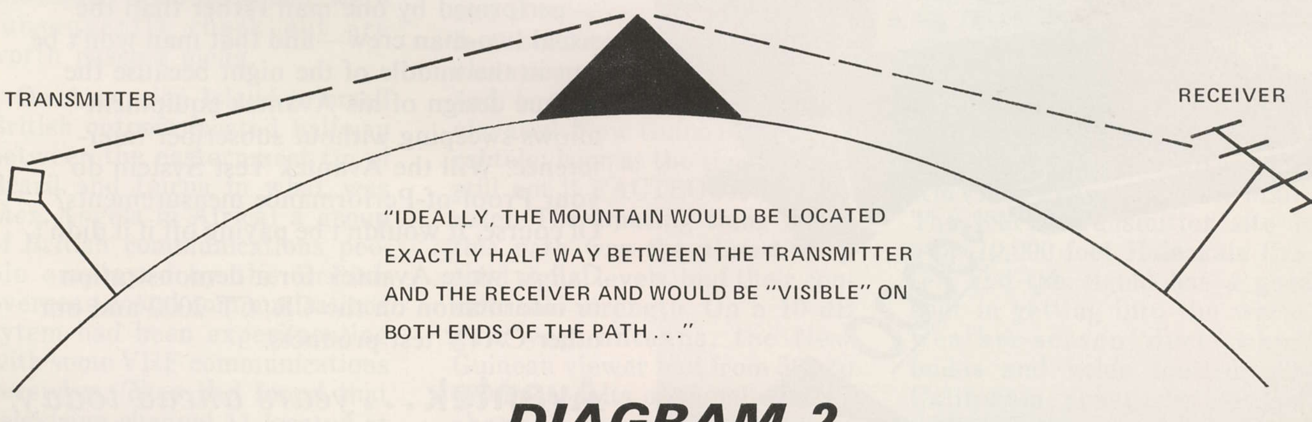


DIAGRAM 2

Columbia River. This meant the base of the towers would be submerged during the high water periods, and there was the danger that logs and debris would tear the towers down. To solve the problem a "log chain" was installed around the tower array to float up with the high water and provide protection to the 16 bay yagi array.After a storm in the summer of 1958 the signal disappeared and the CATV company went to inspect the antenna site. The surface of the high water was unbroken, the log chain had come apart and the entire array, all 16 yagis and both 80 foot towers with catwalk, were at the bottom of the Lake!

It has been the experience of practicioners of the knife edge chasing art that two factors are usually associated with knife edge propagated signals:

(1) The signals are exceedingly stable (often varying only a few dB *all year long*, largely due to the "line of sight" condition that exists from transmitter to refraction peak, and then from the peak on to the receiving site);

(2) The area *"illuminated"* by the peak (i.e. the region where the signal is found) is oftentimes *very* (very) *small*. It depends upon the distance from the peak to you, and, the shape (geometry) of the peak itself. However, it is not unusual to find an area only ten feet across illuminated, and then only perhaps 5-10 feet in height. The usual practice, when such a site is found, and assuming the signal is not all that strong, is to "fill the whole illuminated area" with as many antennas as you can beg, borrow or steal.

Knife edge can often be an excellent low cost replacement for very expensive microwave systems. An example where this may be possible even yet is Patterson, California, a town explored for CATV possibilities in the early 1960's. Patterson sits south and west of Stockton/Sacramento, up against the California Coastal range mountains. Local off-air signals include the Stockton/Sacramento channels. But the *forbidden fruit*, signals from the San Francisco Bay region, are simply not present in the community because of the 2-3,000 foot peaks that run the ridge due west of Patterson.

When approaching the City of Patterson for a franchise in 1964, the applicant promised to bring into the town the then available San Francisco channels. The town, with around 900 potential CATV sets, would normally have to be served by microwave for these terrain-blocked (70 mile) signals. However, the applicant had spent the better part of a week pouring over topographical maps and laying out path profiles for potential knife edge situations, following a gut-hunch that there *had to be* a peak someplace along the path that would illuminate a patch of ground in the Patterson area. Finally three likely spots were noted, and with a portable receiver and a small all-channel antenna the search began. Within an hour, the first two had been crossed off. One had signal, but it was very low in level and in an unaccessible spot that in subsequent years turned out to be a major freeway cloverleaf interchange! The third was perfect, located only 200 yards west of the city limits in the middle of a cotton field all five San Fran-

cisco VHF channels and two UHF channels ran from 70-100 microvolts rock solid on a simple hand-held antenna. The area was typically knife edge in size, only 100 feet wide by forty feet deep. That was nearly 12 years ago and the *present* holder of the unbuilt Patterson franchise is still holding back building the community because of the high cost of microwaving into the small town.

Knife edge is not limited to the tall mountain areas, although it works best there simply because the peaks provide the "gain" when they are properly located. Some really long haul paths of 200-300 miles are posible over the top of the Sierra Nevada range and the taller rocky mountain peaks. Paths up to 300 miles long are routinely in use in Alaska. The peaks do not need to be peaks at all, especially when the path is within the up-to-100 mile length. Even in the relatively flat midwest, gentle rolling terrain with a 200-300 foot ridge (or more where it is available) can and does provide obstacle gains of up to 20 dB in some instances. We'll talk more about finding the illuminated areas shortly.

The easiest knife edge paths to locate are the ones that are built with the assistance of tall peaks. Simply follow the following procedures:

(1) Using 1 to 250,000 series U.S.G.S. maps (available from U.S. Geological Survey, Denver, Colorado, 80225, or, U.S. Geological Survey, Reston, Virgina 22092 for a few bucks per map), tape together the appropriate maps so that you have a full path length from the transmitter site to your receiving area;

(2) Lay a straight edge from the transmitter to the receiving area and mark over the map to indicate the *path* which any signal that would cross the area *would follow*;

(3) Then using straight edge direct-path-line, closely inspect the path to determine what prominent elevations might protrude *into the path* along the way. If the path has multiple protrusions, it will probably be necessay to transcribe what critical 20-30% *mid-point area* of the path (i.e. the region along the path making up the mid 20-30% of the total path length) to a 4/3rd's earth section of graph paper (available at any engineering supply house). This will allow you to plot the *vertical height* of the protrusions along the path as a function of these relative protrusions to the height (referenced to sea level) of the transmitting antenna and the general receiving area. If you find a receiving site that looks like it could "see" a peak that in turn can "see" a transmitter location, you may have a winner.

Where there are multiple peaks along and very close to the path (i.e. the signal just skims by a peak that *had it been* a short distance one way or the other would have been *right along* the path), the actual signal path may *not* follow the straight edge line originally inscribed on the maps. This usually means you need to get *out of the map room* and into the field with some signal searching equipment. We'll have more on this shortly.

Signals Can Be Found

The early days of CATV abound with true stories related by pioneers who made the most of *whatever signals* they could find. TV Signal Service in Mena, Arkansas is one good example. Located around 200 miles northeast of Dallas, pioneer Troy Masters had done some mountain top scouting for signal in 1953. He had located one peak with a flat table top that produced marginal but reliable signal from channel 4 in Dallas. He proceeded to construct a large (wire) rhombic antenna on the site and from this location the residents of Mena, buried at the bottom of a valley in west-central Arkansas, received their first television connection to the world.

Marathon, Ontario is another "rhombic" town. In the summer of 1953, the town's Marathon Company began looking for television service. After a summer of experimentation, a fellow named Grant Ross installed a six wavelength per leg rhombic atop 45 foot poles on a hill 300 feet above the shore of Lake Superior. His object was to produce *reliable* reception from WBAY, channel 2, in Green Bay, *some 305 miles more or less due south!* The WBAY signal traveled over 152 miles of northern Wisconsin countryside before it "launched" over the full width of Lake Superior, an *additional* 153 miles. Ross was more than an experimenter and pioneer CATV system operator (he hooked up 400 + homes at a $50.00 installation fee and collected a then-acceptable $2.50 per month for the service), he was also an ardent amateur *scientist* who *recorded* everything he saw with the long haul signal. In the first 18 months after the installation was completed Ross scribed more than 50,000 words of *observations* into a growing notebook. When in later years a closer channel 2 came on the air in Port Arthur, Ross added it to his system in place of WBAY and rebuilt the rhombic to bring then on the air WLUC from Marquette, a "mere" 166 miles directly across the Lake to Marathon.

Is there a message to all of this, other than the history that early CATV pioneers often spanned *very* large distances?

Yes — that when a person *really has to produce* signals, he *usually* can do so, *if he is willing* to take the time *to look* for the signals. Sadly, in the last 10 to 15 years of CATV, the original pioneering spirit that sent people like Troy Masters to the top of a butte near Mena, Arkansas has all but been lost. Tall towers have replaced what was good seat-of-the-pants signal finding, and perhaps we are not all that much better for the change.

Finding The Signal

There are many techniques for finding wayward signals. A fellow can pour over maps, if he knows what it is he is looking for. Or, a fellow can make an intensive study of off-air recep-

tion conditions in his area. *Fingers*, as noted in the June part one of this report, are around *if* you can find them.

Example: Near the town of Carnegie, in south central Oklahoma, a rural farmer has two ten element channel 11 yagis propped up against his house. They are barely twenty feet above ground. This farmer watches channel 11 in Dallas, nearly 200 miles away, like it was a local (Grade B) signal. Laying the route out over a topographical map shows *no* peaks or mountain ranges intercepting the signal (it would take a 6,000 foot plus peak near the middle of the path to *explain* the signal and the tallest ridge along the route is barely 300 feet above average terrain). The signal *is* consistent, steady, and runs around 100 microvolts. With a decent antenna array, it would be around — 10 dBmV. If you go into the farmer's property with a test antenna and signal chasing device (SLM or portable receiver), you quickly discover that the area where the signal is available is at best a few hundred square yards. By pure quirk of nature, it is centered around his home. And by pure quirk of luck, he installed his home antenna (with rotor) there. Channel 11 in Dallas is *an indie signal*, and it is available more than 100 miles *further out*, reliably, than *any* CATV system that takes it off the air for microwave feed has to date installed off-air antennas. That is *several expensive hops of microwave closer* to the western Oklahoma CATV systems.

This "hot spot" was noticed by a CATV manufacturer's field representative who followed a technique not unknown in the industry, but little practiced. It works like this:

The FM broadcast band, 88 to 108 MHz, is very aptly placed in the spectrum for field measurements. And, thanks to creative Detroit engineering, there are any number of excellent automobile *FM receivers* now available. Therefore, looking for signal fingers and chasing down hot spots is a fairly simple procedure:

(1) *Set your FM radio dial* to the frequency of an FM band transmitter which operates *in the same city* as the desired TV band transmitter. If you can locate an FM broadcast station that happens to *co-share a tower* with one of the TV stations, so much the better because that means the cross-country path from transmitter to you will be *identical* for *both* the FM broadcast and the TV band signals.

(2) *Start driving the area* in criss-cross fashion, using a systematic approach to insure that no regions go un-prospected. Using a local street map, mark off where you find signs of the distant FM broadcast signal. Develop some form of relative scale for signal level, such as (A) "noisey, no stereo", (B) "full quieting monoaural, noisey stereo" and (C) "full quieting stereo".

Using this technique you can scout a typical town and the surrounding countryside in just a matter of hours or a day at most. Then if you have several maximum level spots located, you can break out the portable antenna and portable TV re-

ceiver/SLM and go to work fine-tuning the hot spots for the real signal levels present.

If the FM transmitters are located on shorter towers (i.e. 300/500 foot versus the typically taller TV sticks), you *may* find there is a low percentage of similarity between the FM "hot spots" and the TV "hot spots". It therefore pays to know *which* FM band broadcasters *share* TV towers, usually at some decent height close to the top.

FM automobile receivers typically have sensitivities of 0.5 to 1.0 microvolt for 20 dB of quieting. That means a minus 60 dBmV (FM) level signal is going to provide almost full monoaural quieting in your car. Obviously, a minus 60 dBmV TV band signal is *not* going to do much for you. However, you are using a poor antenna mounted close to the ground and from several years (read two decades) of practical experience utilizing this approach in hundreds of situations, the FM broadcast service quality as received in the car can be "interpolated" as shown here in table one.

There are two other approaches to the problem. If your desired TV channel is channel 6 (or if there is one in the same market you are looking for with a tower *close to* the channel you really want), virtually *any* automobile FM receiver has the capacity to simply *tune down* to 87.75 MHz (just below the bottom of the FM broadcast band) to pick up channel 6 audio. Now the TV transmissions are horizontal, and you are vertical with your automobile antenna (the exception being the GM product cars that stick that lousy so-called dipole antenna inside of the windshield), but that works to your advantage. If you *can hear* the channel 6 audio, cross-polarized as it were (which is automatically 20-30 dB *below* what the channel 6 audio would be on a horizontally polarized antenna), then *when* you copy channel 6 audio you are *really* home free.

Finally, during the past two years several consumer-oriented manufacturers have come onto the market with *"TV Band Radios"*. These are typical consumer plastic-cased jobs that are designed to tune the TV bands from 2-6 and 7-13. The intent is to allow people to *listen* to TV *audio* while they are away from a real TV receiver (some shows like Johnny Carson and the news translate well to audio only, others such as Maude do very badly!) General Electric has a *TV Band Radio* which sells for $35.00. The antenna has a built-in whip antenna (which is not long enough for low band and too long for high band if totally extended) but a little ingenuity will allow you to hook up an *external* mounted-on-the-auto antenna. Now you are in business and can tune in directly the audio (or video — *but* audio is better) on the channel you are after, using the continuous tuning of the receiver. For an antenna, we have found that a "rescued" set of telescoping TV rabbit ears (which *will* extend to 60 inches when fully extended) can be reworked into an adjustable 1/4 wavelength whip antenna (vertical). The proper length varies from just under 54 inches for channel 2 to around 13 inches for channel 13. Or, you can mount one of the replacement set of *twin* rabbit ears on the vehicle and achieve something *similar to* horizontal polarization (although it will now be directional). A purist would worry about matching the antenna to the input impedance of the TV Band Radio; we have not to date. You could also run a splitter off of the car mounted antenna and drive the TV Band Radio and an SLM at the same time.

FM Quality Signal (*)	TV Dipole Level Translation
Monaural — noisy	—50 dBmV
Monaural — full quiet	—40 dBmV
Stereo — noisy	—40 dBmV
Stereo — full quieting	—35 dBmV

It does not take long utilizing this technique to learn a great deal about the affects of terrain, buildings, and even power lines of television (frequency) reception. Listening to noise interspersed with bits of audio is *not* the most enjoyable thing in the world. But it is educational and it could even turn out to be profitable!

Next month we will address ourselves to the localized interference problems and how they can be turned into decibels *and* dollar bills for the enterprising cable operator.

MULTIPLYING LIKE RABBITS
Hams In CATV — II

Good Grief

It all started in the February *CATJ* where a small portion of our card-insert harmlessly asked "Are You A Ham?" Approximately 40 readers, in CATV or a closely allied business, filled in that card and then in our April issue we ran a listing of those CATV people who share the common bonds of Amateur Radio.

Then in Dallas at the 25th annual industry trade show, we supplied some nice 3 inch diameter three color pins for any Hams who wanted to be identified for their hobby interest through the assistance of a small table at the TOMCO booth. We picked up around 60 registrants at the TOMCO booth, a fair number were repeats from the April *CATJ* listing.

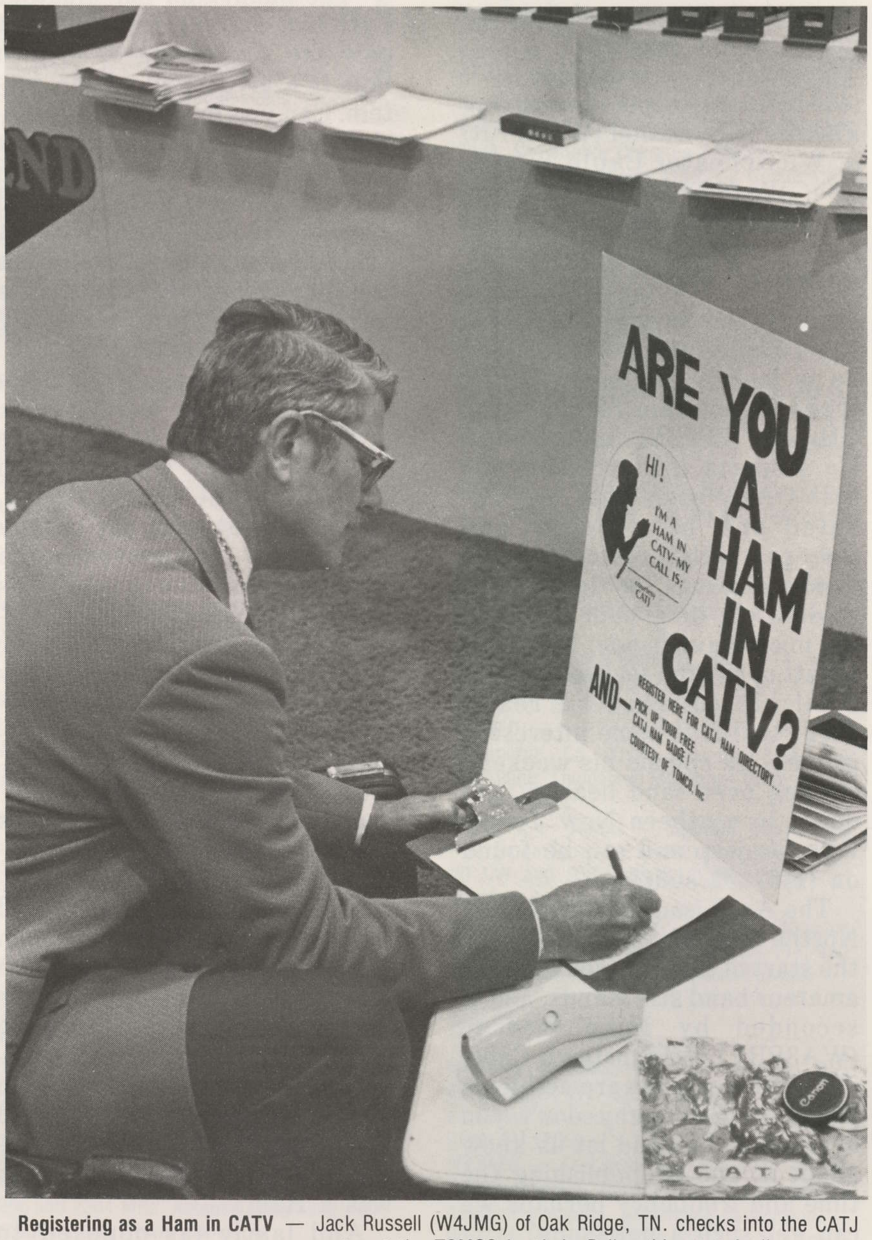
Then the mail started coming in. As this is written, in early May, the list is now beyond 130 "Hams In CATV" and it continues to grow daily.

We sympathize with the guy who publishes the "Callbook"!

While it is still not possible, using the listing here in *CATJ*, to work "All States-CATV", the day may not be far away. If and when it gets close, we will probably feel inclined to create yet one more of those proliferating "special awards" for the "accomplishment".

We are not sure where all of this is headed (although probably not far is an apt answer). This month's *CATJ* card-insert, facing pages 40-41, has yet *another* form for anyone *we have missed* to date. If you do *not* see yourself listed here, assume that we do *not* have the proper information to list you. It should be noted that around ten fellows put down their names and addresses on our Dallas sign-up sheets, but left *off* their Ham calls. Since this is a listing my amateur call signs, you obviously cannot be listed.

There is a not-too-surprising high percentage of CATV hams involved in some form of VHF. It may be simply two meter (FM), but it is VHF none the less. And while the numbers are



Registering as a Ham in CATV — Jack Russell (W4JMG) of Oak Ridge, TN. checks into the CATJ roster at the TOMCO booth in Dallas this past April.

not substantial, there is also quite a few active above 148 MHz in the upper VHF (and UHF) bands.

There is also a surprisingly high spread of hams in top engineering and management positions. Sure, there are linemen who are hams, but there are company Presidents as well. A few with whom we have been talking for years at conventions and on the telephone turned out to be "fellow Hams" and surprised us. John Thomas, of Lindsay Specialty Products was one of those (*but*, 160 meters John?).

Several asked that we pass along through *CATJ* their special communication area interests hopeful that by our doing so we might locate some fellow devotees in the process.

Several are interested in ATV (440 MHz we suspect), including Thomas G.N. Bethel (WA2YFR) at Westchester Cable Television. We wonder whether the Commission would make a local ATV station a "must carry" Thomas.

Mark Dzuban (WB2IRX) is Chief Engineer at GAMCO and he is looking for some CATV types to join him for some 3.3 GHz and 10 GHz "hilltopping". He suspects (and properly so) that CATV sites that are elevated and have power and towers available would make dandy locations for doing some moderately long haul work on the microwave bands. Mark has 1 watt of RF and four foot dishes available so what he really needs to find is some interested parties. He spends his weekend chasing over sand beaches and dunes in southern New Jersey with his jeep and can be found on (146) .52 simplex.

The April issue suggestion by Northe Oserink (WA6ZEM) for the start of a CATV net on some amateur band still stands, and is seconded by Mike George (WA3PRY) of Johnstown Cable TV. Both you guys are active on 20 meter SSB, why don't you arrange a sked and let us know about it, and by publishing the time and frequency perhaps we can get such a net going?

A fair percentage are active in the Oscar (amateur satellite) program, and Jerry Kyllo (WA7WAD) and others wonder about CATV people getting together via Oscar. *Why not?*

John Petter (WA6ZFL) who works for the touch-tone mad scientist Tom Olson at TOMCO is really into repeaters. He wrote "I am very much involved in mountaintop UHF linking (FM) of repeaters. I have talked from here in Mountain View using a 1 watt 440 MHz rig to southeastern Arizona, Las Vegas, Reno, etc. on UHF linking. There are over ten UHF hops to get from here to Arizona, all touch-tone remote controlled.

"The quality on our amateur UHF link circuits is so good that only the long string of squelch tails is a give away to the system. Can you imagine the confusion and surprise when we hook an in-band 2 meter repeater in Tuscon to a two meter in-band repeater in San Jose, without prior announcement! All lines are duplex and the dialogue is beyond anything normally heard on the amateur bands."

Olson, you have created a monster.

We apparently do not have any FCC types who are also amateurs in the United States, but there is at least one in Canada. VE2RV is "involved in the regulatory function of CATV" as District Manager of the Department of Communications, for Telecommunications Regulations.

Finally, we should acknowledge the three Japanese amateurs who are involved in CATV and who signed up at the Dallas show. And the enrollment of Arthur Swain (VP2VJ) who is involved with the operations of the recently completed British Virgin Islands system for which Jerrold supplied equipment. We note that Tony Gargano (W2EHB), International Marketing Manager for Jerrold is in our listing. Could it be you two guys worked side by side in Tortola and never knew the other was a Ham?

And lastly (as opposed to finally), the special listing for the Hams who work at Theta-Com in Phoenix may well inspire similar listings in a future issue from Hams who are employed by other CATV manufacturers. We have noted in our visits to other CATV plants the large number of Hams employed. . .but *please fellows* let's not start a race to see which manufacturer has the *most* Hams employed! Let's keep the listings to those who *really are* involved in CATV areas.

The Callbook we are not. . . although the following list may suggest otherwise.

First District

K1IED — Larry Skilton, 72 Brook St., South Windsor, Ct. Active 160-2 meters.
W1RXE — Howard C. Arnold, 512 Elliott St., Beverly, Ma. 01915. Consultant and Internation Sales Manager, Microwave Filter Co.; active 80-10 meters and 2 meters.

Second District

W2EHB — Tony Gargano, 32 Bryant St., Blackwood, N.J. 08012. International Marketing Manager, Jerrold Electronics Corp.; Active 80-10 and 2 meters. Interested skeds.
WA2FMR — Philip Dubs, 385 Salem Ct., Hauppauge, N.Y. 11787. 144 and 450 FM; interested in skeds.
K2HTE — Joseph D. Burgess, Hanover Hill Rd., Wellsville, N.Y. 14895. Owner, Allentown Cable TV; 6 meters, interested in skeds.
W2IBN — George Treiber, 785 Hunt Lane, Manhasset, N.Y. 11030. Active "all" bands.
W2IFK — Carl J. Lump, RD 2, Box 20, Ringoes, N.J. 08851. Active 80-10, 2 meters.
WB2NDK — Stephen A. Weisberg, 300 E. 40th St., New York, N.Y. 10016.
WB2NIB — James R. Greene, Stevens Manor Apts. 11-G, Middletown, N.Y. 10940. Operates 144 and 450 MHz. Pro-Com Electronics, Poughkeepsie, N.Y.
K2RKP — Jack Radzik, RD 1, Podunk Rd., Trumansburg, N.Y. 14886. Operates 75 meters, interested in skeds. CE for Ceracche TV Corporation, Ithaca.
WB2IRX — Mark Dzuban, 304 Pat Rd., Barnegat, N.J. 08005. Operates 144 MHz up. Chief Engineer, GAMCO Industries, Inc. Roselle, N.J.
K2RVF — Bill Leventer, 18 Bruce Lane, E. Northport, N.Y. Operates 2 meters.
W2TQK — Walter E. Pfiester, Jr., 1 Skadden Terrace, Tully, N.Y. 13159. Field Engineer, Eastern Microwave. Operates 75, 20 SSB, interested in skeds.
WB2VRZ — Neil Serafin, 119 Thompson Rd., Syracuse, N.Y. 13206. Operates 75, 40 SSB and 2 FM. Salesman for Syracuse New Channels, interested in skeds.

WA2YFR — Thomas G.N. Bethel, Pleasant St., Bedford, N.Y. 10506. Operates 20 SSB, 144 and 450 MHz. FM. Chief Engineer, Westchester Cable Television.
WA2YKM — Raymond M. O'Donnell, 215 Main St., Wellsburg, N.Y. 14894. Operates 75, 20 and 2 meters. Assistant CE for Valley TV Cable.
K2ZLA — F. Baxter, P.O. Box 765, Schenectady, N.Y. 12301. Operates 80-10; employed by GE Cablevision.

Third District

W3COG — Louis N. Seltzer, P.O. Box 231, Coatesville, Pa. 19320. Operates "all" bands, management, Cable TV of Chester County.
W3DGX — Ted Gibson, 19 W. Pottsville St., Pine Grove, Pa. 17963. Operates all bands, licensee WR3ACI (04/64). Engineer, Pine Grove TV Cable.
W4FRO/3 — Tracy "Trace" Levy, 401 East Sixth St., Laurel, De. 19956. Operates 80-10 CW only. Responsible for microwave for General Television, Inc.
WA3MXD — Ralph Spence, 16 S. Broad St., Honey Brook, Pa. 19344. Operates 80-10 meters, is interested in skeds. Headend and bench maintenance, Cable TV of Chester County.
WA3NCM — James C. Moore, 53 Main St., Freeport, Pa. 16229. 20 phone, 2 FM, interested in skeds. Bench and headend technician, West Moreland Cable Co.
W3NTD — Jack Jones, City Line and Monument, Philadelphia, Pa. 19131. Operates 10 and 6 meters, also licensed as WA3RBZ. WCAU-TV, Philadelphia.
WA3PRY — Mike George, 331 Stonycreek St., Johnstown, Pa. 15901. Operates 80, 40, 20 CW and SSB. Chief technician, Johnstown Cable TV.
WA3RWL — Richard J. Brong, 1746 E. Chocolate Avenue, Hershey, Pa. 17033. Operates 75 SSB, 6 AM and 2 FM. Construction and field engineer, Lightning Electric of Pa., Inc.
WA3WDV — Howard "Al" Rhodes, Jr., 1107 Lake Heron Drive, Annapolis, Md. 21403. Operates VHF/UHF. Consultant, Annapolis CATV, Inc.

Fourth District

K4BOJ — R.C. Townley, 4715 Barby Rd., Montgomery, Al. 36108. Operates 20 SSB, CW, interested in skeds. Engineering, WSFA-TV.
K4BSE — Jim Farmer, 3202 Moss Oak Dr., Doraville, Ga. Operates 40, 20, 15, interested in skeds. Senior Engineer, Scientific-Atlanta, Inc. Atlanta, Ga.
K4EFV — Larry Perry, Box 461, Oak Ridge, Tn. 37830. Operates 80 meters thru 432 MHz, interested in skeds.
K4FXK — Britt Belyea, 92 Waterview Dr., Newport News, Va. 23602. Operates 144, 220 MHz. Director of operations, Hampton Roads Cablevision, Newport News, Va.
W4GO — Bernie Holtman, P.O. Box 1000, Louisville, Ky. 40201. Operates 75 thru 2 meters. Director of Engineering, Orion Broadcasting, Inc. (Orion is part owner of MSO).
WB8KPM/4 — Dale E. Brock, 118 N. Main, Bowling Green, Ky. 43402. Operates 6 and 2 meters, interested in skeds. Chief Technician, Wood TV Corporation.
WA8OYF/4 — Barney Welton, 4380 39th St. South, St. Petersburg, Fl. Operates two meters.
W4JKY — William C. (Bill) Martin, 210½ Broadway, Paintsville, Ky. 41240. Operates 40, 20, 15 meters, interested in skeds. Manager, TV Cable Corp., Paintsville, Ky.
W4JMG — Jack Russell, Bldg. 3500, P.O. Box "X", Oak Ridge, Tn. 37830. Operates 80-20 meters. Engineering industrial CATV system in Oak Ridge.
WB4KSS — Randy Rhea, 4141 Brockett Creek Dr., Tucker, Ga. Operates 80-10 meters.
K4LCK — James H. Daniels, Box 117, Auxier, Ky. 41602. Operates 2 meters. Owner Auxier Cablevision.
WA4MNM — Tom Osborne, Box 46, Robinson Creek, Ky. 41560. Operates 80-10 meters. Co-owner, Osborne TV Cable, Robinson Creek, Ky.
K4NTA — Ted A. Huf, 1495 NW Britt Rd., Stuart, Fl. 33494. Operates 50, 144 and 432 MHz, interested in skeds. Engineer, Perry Cable Company.
K4OII — Barry Ankeny, 4449 Coconut Rd., West Palm Beach, Fl. 33406. Operates 80 meters "up", interested in skeds. Director of CATV Engineering, Burnup & Sims, Inc., W. Palm Beach.
WB4SXX — Bill Meacham, 222 Atkinson St., Laurinburg, N.C. 28352. Operates 160-10 CW, SSB and 2 FM; interested in skeds. Chief technician for Community Antenna Co.
W4VBT — B.L. Coleman, P.O. Box 577, Petersburg, W. Va. 24963. Operates 6 meters, might be interested in skeds. Chief Engineer, Master Telecable, Inc.
WA4VUY — Clarence C. Miller, 1115 NW 4th St., Gainesville, Fl. 32601. Operates 75, 40, 20, 15, 10 and 2 meters. Chief technician, University City TV Cable Co.

Fifth District

K5AD — Mac Ferguson, P.O. Box 871, Henderson, Tx. 75652. Operates 3803 kHz (stay with it Mac!).
K5AK — Ray Narad, 9352 McCabe Drive, El Paso, Tx. 79925. Operates 80-10 meters; Tech Associate at Sylvania.
W5ATO — J.R. Willis, P.O. Box 296, Granite, Ok. Operates 75, 2 meters. Partner, Granite Televue.
W5BGW — Frank Narramore, Box 605, Yellville, Arkansas 72687. Operates 80, 20, 10 when active; interested in skeds. Manager, TV Cable Co., Yellville, Ark.
W5CDC — David P. Callahan, 5509 Falls Rd., Dallas, Tx. 75220. Operates 80, 40, 20 meters.
W5CHE — H.C. Ford, P.O. Box 296, Granite, Ok. Operates 75 and 2 meters. Partner, Granite Televue.
K5FNK — Paul Harrison, 4904 Jordan Dr., Fort Worth, Tx. 76117. Operates 50, 144 and 220 MHz.
K5HSP — John Lord, 16 N. 4th Ave., Clayton, N.M. 88415. Operates 75, 2 meters, interested in skeds. Manager, Clayton TV Cable.
W5KHT — Bob Cooper, Jr., 4209 NW 23rd, Suite 106, Oklahoma City, Ok. 73107. 50, 144, 220 MHz. Editor, CATJ (Also K6EDX).
WA5LBC — Jack M. Threadgill, 803 Tanglewood, Bryan, Tx. 77801. Operates 75, 40 meters. Engineer, Hearne Cablevision.
W5LCU — Bill Jatroe, 10014 Murray Brook, Houston, Tx. Operates 40, 20 CW.
K5PJR — Tony R. Bickel, P.O. Box 1050, Grove, Oklahoma 74344. Operates 144, 432, 1296 and 2304 MHz. Antenna design engineer, consultant, US Tower Company.
W5PLX — Bruce K. Frazer, 1514 Sherman, Arlington, Tx. Operates 50, 144 MHz.
K5QMY — W.G. "Bill" Comeaux, 8067 La Salle Ave., Baton Rouge, La. 70806. Operates 80, 40 and 2 meters. Employed by Futronics, Inc.
WB5RGY — Joseph J. Wormser, 7106 Meadow Rd., Dallas, Tx. 75230. Operates 40, 20 CW; interested in skeds. Manager Production Engineering, TOCOM.
W5TMJ — Alan Hartzell, P.O. Box 267, McAlester, Ok. 74501. Operates 20, 15 and 10 meters. Engineer, McAlester Cable TV.
W5USM — Bill Smith, 2706 National Circle, Garland, Tx. 75401. Operates 160-10, 6 and 2 meters. VP, CADCO, Inc.
K5UMV — Walter C. Dillard, 605 N. Washington, Mufreesboro, Ark. 71958. Operates 80-10 when active, interested in skeds. Owner, TV Cable Company.
WA5YVY — Robert Sherwood, 9253 McCabe Dr., El Paso, Tx. 79925. Operates 80-2 meters. Employed as Manager, Sylvania Transmission Products Design.
WA5RIX — Al Tucker, 4909 Rand, Dallas, Tx. 75216. Operates 160 thru 2 meters.

Sixth District

WA6CAW — Lon Marvin, 19912 Canyon Drive, Yorba Linda, Ca. 92626. 2 FM and 450, interested skeds. ITT Cannon Electric Division.
WA6EZL — James Rieger, Code 3743, China Lake, Ca. 93555. Operates 2 meters up, interested in skeds. Naval Weapons Center CATV system.
WA6GEJ — Raymond E. Crawford, 21805 Hwy. 18, Apple Valley, Ca. 92307. 6 and 2 meters, interested in skeds. Chief Engineer, Apple Valley TV Cable Co.
WA6GHQ — Dan Sofie, 7119 Pomelo Dr., Canoga Park, Ca. 91307. Operates 20 DX, 75 ragchew.
WA6PKN — Jerry Plemmons, 1011 Bryant St., San Francisco, Ca. 94103. Operates 80-10, 144 and 450 MHz, interested in skeds. Employed by KQED-TV.
WB6QKA — Warren Reihs, 3007 Rollings Avenue, Thousand Oaks, Ca. 95051. Operates 2 FM.
W6RXU — Frank Genochio, 428 Luther Drive, Santa Clara, Ca. 95051. Operates "all bands", SSB and CW, interested in skeds. President of CATEL, Inc.
K6RZU — Larry Flaherty, Box 1711, Monterey, Ca. 93940. Operates 80-10 and 2 meter FM. Chief Engineer, MPTV.
W6WED — Stanley Boyle, 13041 Cerise Ave., Hawthorne, Ca. 90250. Operates 80-10. VP Marketing, Engineered Magnetics Division, Gulton Industries.
WA6ZEM — Northe K. Oserink, 3401 Floral Rd., Santa Cruz, Ca. 95062. Operates 80, 40, 20 CW and SSB. Senior Publication Writer, Avantek, Inc.
WA6ZFL — John Petter, 1077 Independence Ave., Mt. View, Ca. 94043. Operates 144, 440 MHz closed repeaters. Engineer, TOMCO.

Seventh District

WB7AHL — Donald R. 'Bob' Johnston, Box 483, Lander, Wy. 82520. Operates 80-40-20, interested in skeds. District Engineer, Lander Cable TV (TCI).
WA7AZO — Carl Rothermel, Box 494, Goldendale, Wn. 98620. Operates (mostly) 15 meters. Assistant manager, Goldendale Cablevision.
WB7CQL — Ron Oberloh, 3311 E. Sunnyside Lane, Phoenix, Az. 85032. Operates 80-"up".

K7EWG — Carl E. Schmauder, Box 815, Lincoln City, Or. 97367. Operates 75, 10, 2 meters. Manager, Lincoln Television Systems, Inc.
W7LBN — Don Morton, 610 E. Loyola Dr., Tempe, Az. 85282. Operates 80-"up".
W7PT — Phillip "Phil" H. Barnhart, Box 983, Cody, Wy. 82414. Operates 80, 40, 15 and 2 FM; interested in skeds. Manager/Chief Technician Cody-Powell Cable TV (TCI).
WA7TCQ — R.S. "Joe" Pinner, 695 North 9th, Lander, Wy. 82520. Operates 160-10, interested in skeds. Chief technician, Telecommunications, Inc.
WA7WAD — Jerry Kyllo, RFD, Lacrosse, Washington 99143. Operates 2 meters, Oscar VII mode B. Technician, Pullman TV Cable Company.

Eighth District

K8BOT — Jim Palmer, 1905 Parkwood Dr., Parkersburg, W. Va. 26101. Operates 80-10, 50 and 144 MHz.
K8EDG — John L. Nowak, 3153 Belmont St., Bellaire, Oh. 43906. Operates 80-10, interested skeds. Manager, Bellaire Tele Cable Co.
K8HLH — Bob J. Heim, 105 W. Shoreline Rd., Sandusky, Oh. 44870. Operates 80, 40, 15, 10 and 6 meters. Chief Engineer, North Central TV.
WA8MHG — Edgar Geiman, 49 W. Jefferson St., Quincy, Mi. 49082. Operates 80, 40, 10 and 6 meters.
W8PTX — John McDowell, Box 467, Plainfield, Oh. 43836. Operates 2 FM.
WB8VPI — Raymond Chapman, 1 E. Main St., Richwood, W. Va. 26261. Operates 2 meters, interested in skeds. Manager, Richwood TV Cable Co.
K8YZW — Jack Leishman, 2390 E. Carriage Hill Dr., Traverse City, Mi. 49684. Operates 80-2 meters, interested in skeds. Consultant, Midwestern Cablevision.

Ninth District

K9CVW — Raleigh B. Stelle, III, 7101 E. 43rd St., Indianapolis, In. 46226. Operates 40 CW, interested in skeds. Sales Engineer, Texscan, Inc.
K9HJN — William J. Draeb, Ellis Rd., Rt. 2, Kewaunee, Wi. 54216. Operates 80, 40 and 2 meters when active. Chief engineer, Draeb Enterprises.
WA9HZT — William H. Ellis, 1018 Lincoln Ave., Evansville, In. 47714. Operates 2 FM. Technical management, Telesis Corp.
W9MRE — Tom Wendt, 702 Euclid, Marion, In. 46952. Operates 75-10, 2 meters. Employed by Marion Cable Television (ATC).
WA9UDO — R. Ramme, 993 Oak, Aurora, Illinois.
WA9UDQ — Richard Tidberg, RR #2, Box 119A, Winnebago, Ill. 61088. Operates 20, 6 FM, 2 FM, 432 ATV, interested in skeds. Employed by Illinois Bell Telephone Co.

Tenth District

WN6FDG/Ø — Michael Thomas Douglass, 2305 Main, Emmetsburg, Io. 50536. Operates 40, 15 CW when active. Lineman, Emmetsburg Cable TV.
K8JCB/Ø — Reynold J. Johnson, Box 1425, Ft. Madison, Io. 52627. Operates 80 thru 2 meters, interested in skeds. Chief Technician, Iowa Video (ATC).
WA5VSG/Ø — Henry Kallina, 108 E. 5th St., Atlantic, Iowa 50022. Operates "all bands".
WAØKDE — Ray Pautz, Route 1, Warrensburg, Mo.
KØLCB — David C. Bland, Box 1059, Independence, Mo. 64051. Operates 160-10, 50 and 144 MHz. Program Production, Director of Broadcasting.
WBØODW — John F. Johnston, 4705 N. Carefree Circle, Colorado Springs, Co. 80917. Operates 40 meters, interested in skeds. Technician, Cablevision of Colorado Springs.
WBØOHS — G.M. Sanderson, 983 Country Acres, Wichita, Kn. 67212. Operates 2 meters.
WBØOZQ — David Browning, P.O. Box 265, Springfield, Co. 81073. Operates 80, 40, 2 meters, interested in skeds. Manager, Springfield TV Cable.
WØPQN — Gary Atkins, 430 Garland St., Lakewood, Co. 80226. Operates 80-10 meters, interested in skeds. District Manager, RIA Colorado.
WØRAH — Bud Campbell, 360 S. Monroe St., Denver, Co. 80209. Inactive.
WAØTFW — Jerry Kettleseon, 321 S. Main St., Milband, S.D. 57252. Operates 80 and 20 meters. Technician, Community Cable Co.
WAØZFE — Philip R. Brown, 1004 Main St., Winfied, Kn. 67156. Operates two meters, interested in skeds. Employed by Cowley Cablevision, Inc.

Canadian

VE2RV — Ross Harvey, 143 Papineau St., Sept-Iles, Que., G4R 4H6. Operates 80-10 and 2 meters. District Manager, Department of Communications, Canadian Government.
VE3BVX — John Thomas, 11 Suxxex N., Lindsay, Ontario. Operates 160, 2 meters. President, Lindsay Specialty Products Ltd.
VE3CDX — Barry Garratt, Foymount, Ontario. Operates 160 meters through 1296 MHz (also VE2OJ).
VE3CFA — Frank Verkalk, 5 Kenninghall Blvd, Streetsville, Ontario.
VE3DVA — Geoff Wade, 37 Apple Orchard Path, Thornhill, Ontario. Operates 80-10 meters.
VE3UP — Paul Hrivnak, 146 Meadownvale Rd., West Hill, Ontario. Operates 80-10 meters.
VE4UD — Bill Evans, 313 Carpathia Rd., Winnipeg, Manitoba R3N 1T2. Operates 80 thru 2 meters. Coordinator, local broadband network, Manitoba Telephone System.
VE7BVP — Shannon D. Holt, 594 11th Ave nue, Campbell River, B.C. V9W 4G4. Operates 80 and 20 meters, interested in skeds. Chief Technician, C.R.T.V. Association.
VE7XK — Walter Green, 2726-7th Port Alberni, B.C. V9Y 2J7. Operates 75, 20, 15, 10 and 2 meters. Management, Alberni Cable Television, Ltd.

Foreign

JA2ONQ — Hidesato Umemoto, 2-77 Ongi, N/S/KU, Nagoya, Japan. Operates 50, 144 MHz.
JA3MNO — Masami Sato, 48 Tsukimigaoka Yatoni-Cho, Nagoya, Japan. Operates 20 meters.
JA9JF — Norimitsu Yonoda, 6-20 Tsukumo, Fukui City, Japan. Operates 15 meters, 144 and 432 MHz.
VP2VJ — Arthur Swain, P.O. Box 440, Roadtown, Tortola, British Virgin Islands. Operates 20, 40 and 15 meters. Employed by Cable and Wireless special technical services (CATV).

HAMS AT THETA-COM

"Enclosed a listing of Hams who work at Theta-Com, and their respective activities. We think the idea of listing Hams in CATV is a good one. We enjoy **CATJ** and think your technical philosophy is great!

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73,
Bert L. Henscheid (WA7CBO)
Chief Engineer
Theta-Com, Phoenix

WA7BNF — David Allen, CATV repair tech; operates CW and SSB.
WN7BVB — Boyd Reifschneider, Eng. Lab Tech; operates CW.
WA7CBO — Bert Henscheid, Chief Engineer, CATV; operates 144, 440 MHz.
WA7DTL — Henry Semback, Eng. Lab Tech; operates 144 MHz plus CW, ATV.
WA7GMD — Jack Crabtree, Eng. Lab Tech; operates Oscar and CW.
W7HMU — Bernie Cater, Engineer; operates 75-10 meters.
K7IJS — Chuck King, Senior Design Engineer; operates 144 MHz.
WA7IMD — Pat Birney, Application Engineer; operates 50 MHz.
W7KXX — Bernie Sigmon, Microwave Engineering Manager; operates 144 MHz.
K7MLE — Ray Adams, Senior Design Engineer; operates 50, 144 MHz.
WA7NQT — Bob Quick, Eng. Lab Tech; operates "RTTY"
WA2WUF/7 — John Parker, Field Engineer; Operates CW, SSB, RTTY.

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TECHNICAL TOPICS

MEXICO CATV CONVENTION

The National Chamber of Cable Vision (CANITEC), the national trade association for Mexican CATV systems, is holding its 1976 annual convention July 11-13th in Acapulco.

Site of the convention is the Acapulco—Princess Hotel. All convention meetings, and the exhibit of CATV equipment at the show will be housed at the same facility. It is an ideal setting surrounded by a collection of golf courses and the ocean.

Room rates at the Acapulco—Princess vary from $26.00 to $30.00 for single and double rooms to $75.00 for suites.

The Mexican CATV industry is currently experiencing a period of substantial growth. Approximately 325 new federal permits for CATV in Mexico have been issued in the past 18 months, and numerous new systems are under construction. The Mexican CATV industry has use of a 1.2 GHz (relatively low frequency) microwave band for transporting signals from off-air sites to main distribution hub terminals, and they **also** have use of a range of TV channel-width spectrum in the U.S. equivalent of super-band (i.e. 230-300 MHz). It is the use of the so-called super-band frequencies for CATV point to point relay that has experienced the greatest growth in the past one year. Several U.S. suppliers are currently manufacturing block conversion units that take (for example) channels 2-4 off of a cable headend site, frequency convert them to some 230-300 MHz range, and then run them through a 1.0 to 10.0 watt output amplifier for relay on to another headend site. Many of these VHF point to point systems are utilizing CATJ-contrived 15-25 foot parabolic dish antennas (**see CATJ for July 1974**) which at this frequency range provide 18-22 dB of forward gain. With a similar parabolic antenna on the receiving end of the circuit, point to point spans of 70 miles from elevated sites are **not** uncommon.

At the receiving end of the terminal, the super-band allocated channels are block converted back down to the original starting-off channels and cable-carried to their destination. Such installations cover relatively great distances at very low cost (often under $1000.00 **per channel** for transmit and receive equipment).

While most of the new Mexican CATV system growth is largely or totally dependent upon Mexican TV broadcast stations for off-air product, a growing number of systems are also taking border-located U.S. signals well inland through repeated point to point relay stations. At the present time, the government climate for CATV growth in Mexico is rated ''excellent'' by most participants.

Details on attending CANITEC-II are available from: ''CANITEC'', Camara Nacional de la Industria de Television or Cable, Liverpool 143-304, Mexico 6, D.F.

SAT TERMINALS AGAIN

With the filing of a receive-only terminal application utilizing a 4.5 meter dish for their Minot, North Dakota CATV system (**see CATJ, May, 1976, page 30**), TCI may be the front-runner in a **serious** challenge of the Commission's willingness to stick by their ''9 meter and up'' antenna aperture criteria.

Commission sources indicate that **unless** a serious test-case is mounted at the Commission, that there is no inclination on the part of the Commission to ''re-visit'' the 9 meter and up criteria **soon**. The same Commission sources indicate, however, that if a serious ''test case'' is filed, that they would welcome it and that they would be willing to seriously re-consider in CATV receive-only applications the necessity for the larger antenna size criteria.

Any application for a receive-only-terminal filed must in itself be complete and must by necessity respond to two important areas which the Commission considers essential to the relaxing of the 9 meter criteria.

Number one: A technical showing that the system will not generate interference (receive only terminals naturally would not generate anything) and that such a terminal is constructed by the user with the full owner-acceptance of any future interference from other satellites which might occur.

Number two: A public interest showing that it ''is in the best interests of the public that the 9 meter criteria be waived'' or alternately ''modified'' for receive-only terminals.

Can it be done? The truth is that it has **already** been done. In Alaska, RCA-provided terminals have been accepted which utilize many 4.5 meter dish antennas. These are receive **and** transmit terminals, and there is every indication that if the under 9 meter criteria is ''sticky'' on receive-only, it is several times as ''sticky'' when transmit is added to the terminal. It is one thing for a **receive-only terminal** to experience communications system interference from another bird operating on the same downlink frequency, but it is quite another matter for a **bird** to receive **uplink** signals from two or more satellite transmit terminals simultaneously, when only one of those terminals is ''desired''.

Then very recently the Commission approved a Cities Service Corporation application for a 4.5 meter receive **and** transmit terminal located on an off-shore drilling rig approximately 105 miles out to sea east of Houston, Texas. This terminal (licensed as WB39) will provide what the Commission calls ''essential communications'' to the drilling rig; that is, two-way voice and data communications via satellite to land-based receiving terminals. The Cities Service application was approved largely because in the application the oil firm demonstrated that it was in dire need of the communications, and that by employing its particular choice of modulation format **and** uplink frequencies, it would avoid ''keying'' any non-desired on board satellite receiver-transmitter combination. The Alaska applications for 4.5 meter dishes were similarly accepted; largely because while the antennas are small, the choice of modulation format and uplink frequencies largely precluded any misdirected uplink signals from triggering the wrong bird receiver/transmitter combination. Three additional off-shore rig applications, also employing 4.5 meter dishes, are nearing Commission action at this time, these having been filed by EXXON.

Recently CATJ received a telephone call from a communications consultant representing a major oil company, the subject was receive-only terminals for off-shore drilling rigs. The terminals discussed would receive (via license) HBO programming for television reception service on the off-shore rigs. Presently, those rigs located on the ''outer continental shelf'' (as defined by the **Outer Continental Shelfs Act** enacted by Congress some years ago) **are** subject to U.S./FCC jurisdiction. Most of these sites do not depend on off-air reception for television service; rather they are served by bicycling videotapes from the ''shore'', tapes made at some undisclosed U.S. location for delayed ''broadcast'' showings. The oil firms currently spend up to $25,000.00 per year per off-shore rig to make this ''programming'' available to their rigs, and to them the economics of receiving HBO programming for about the same one-time cost makes excellent sense (i.e. a 4.5 meter terminal costs around $25,000.00, and if the terminal with some additional bucks can **also** be utilized for **other purposes** as well, the HBO programming delivery via satellite sort of rides along ''free''.)

The $25,000. question? If the Commission has **already approved** 4.5 meter dish systems for the off-shore Gulf area and Alaska, why should the CATV industry get hung-up? The answer is that the approvals to date have been for ''essential commincation services''. In the Alaska case, RCA simply muscled this one through. In the Gulf of Mexico cases, the applicants showed (1) the communications service was essential, and, (2) that a 9 meter or larger dish antenna would require them to build drilling rigs several times as large as they presently are, simply to hold the dishes in the storm-tossed environment (all of which would be reflected in increased gasoline costs. . .). So the Commission has gone along, **in these circumstances**.

The message seems to be that there is a ''world of difference'' between ''entertainment programming'' and ''essential communications''. Which may suggest **one** way that a CATV system **could** get land-permission for a smaller terminal, simply put together a package which includes some ''essential communications'' aspect along with delivery of HBO. Of course that is more simply said than done, largely because most terrestial locations are within a hop or two of existing terrestial video or data or voice services.

There is the gnawing feeling that the hold-up is not as technical as it is political. The Commission still has pending a long-term study of satellite spacings. Everyone talks as if the 4 degree spacings were an accomplished fact. ''Not so'' says one Commission source. ''They are rec-

cata ASSOCIATE MEMBER ROSTER

In recognition of the untiring support given to the nation's CATV operators, and their never-ending quest for advancement of the CATV art, the COMMUNITY ANTENNA TELEVISION ASSOCIATION recognizes with gratitude the efforts of the following equipment and service suppliers to the cable television industry, who have been accorded ASSOCIATE MEMBER STATUS in CATA, INC.

Anixter-Pruzan, Inc., 1963 First Ave. S., Seattle, WA. 98134 (**D1**)
Avantek, Inc., 3175 Bowers Avenue, Santa Clara, CA. 95051 (**M8**)
Belden Corp., Electronic Division, Box 1327, Richmond, IN. 47374 (**M3**)
BROADBAND ENGINEERING, INC., 535 E. Indiantown Rd., Jupiter, FL. 33458 (**D9, replacement parts**)
Burnup & Sims, Box 2431, W. Palm Beach, FL. 33401 (**S2, S7, S8**)
Cerro Communication Products, Halls Mill Road, Freehold, NJ. 07729 (**M3, M5, M7**)
COMM/SCOPE COMPANY, P.O. Box 2406, Hickory, NC. 28601 (**M3**)
ComSonics, Inc., P. O. Box 1106, Harrisonburg, Va. 22801 (**M8, M9, S8, S9**)
CORAL, INC., 400 Ninth Street, Hoboken, N.J. 07030 (**M1, M4, M5, M6, M7, D3**)
DELTA BENCO CASCADE INC., 40 Comet Ave., Buffalo, N.Y. 14216 (**M4, M7, M8, D3, S8**)
Jerry Conn & Associates, 550 Cleveland Ave., Chambersburg, PA. 17201 (**D3, D5, D6, D7**)
C-COR ELECTRONICS, Inc., 60 Decibel Rd., State College, PA. 16801 (**M1, M4, M5, S1, S2, and S8**)
DAVCO, Inc., P.O. Box 861, Batesville, AR. 72501 (**D1, S1, S2, S8**)
ENTRON, Inc., 70-31 84th Street, Glendale, NY. 11227 (**M4, M5, D4, D5, S8**)
GAMCO INDUSTRIES, INC., 317 Cox St., Roselle, NJ. 07203 (**M5**)
JERROLD Electronics Corp., 200 Witmer Road, Horsham, PA. 19044 (**M1, M2, M4, M5, M6, M7, D3, D8, S1, S2, S3, S8**)
Kay Elemetrics Corp., 12 Maple Avenue, Pine Brook, NJ. 07058 (**M8**)
Magnavox CATV Division, 133 West Seneca St., Manlius, N.Y. 13104 (**M1**)
Microwave Filter Co., 6743 Kinne St., Box 103, E. Syracuse, NY. 13057 (**M5, bandpass filters**)
MID STATE Communications, Inc., P.O. Box 203, Beech Grove, IN. 46107 (**M8**)
Pro-Com Electronics, P.O. Box 427, Poughkeepsie, NY. 12601 (**M5**)
PRODELINE, INC., 1350 Duane Avenue, Santa Clara, CA. 95050 (**M2, M3, M7, S2**)
Q-Bit Corporation, P. O. Box 2208, Melbourne, Florida 32901 (**M4**)
QE Manufacturing Co., Box 227, New Berlin, PA., 17855 (**M9, tools & equipment**)
RMS CATV Division, 50 Antin Place, Bronx, NY. 10462 (**M5, M7**)
Sadelco, Inc., 299 Park Avenue, Weehawken, N.J. 07087 (**M8**)
SITCO Antennas, P.O. Box 20456, Portland, Oregon 97220 (**D2, D3, D4, D5, D6, D7, D9, M2, M4, M5, M6, M9**)
Systems Wire and Cable, Inc., P.O. Box 21007, Phoenix, Az. 85036 (**M3**)
TEXSCAN Corp., 2446 N. Shadeland Ave., Indianapolis, IN. 46219 (**M8, bandpass filters**)
Theta-Com, P.O. Box 9728, Phoenix, AZ. 85068 (**M1, M4, M5, M7, M8, S1, S2, S3, S8, AML Microwave**)
TIMES WIRE & CABLE CO., 358 Hall Avenue, Wallingford, CT. 06492 (**M3**)
Titsch Publishing, Inc., P. O. Box 4305, Denver, CO 80204 (**S6**)
Tocom, Inc., P.O. Box 47066, Dallas, Texas 75247 (**M1, M4, M5, Converters**)
TOMCO COMMUNICATIONS, INC., 1132 Independence Ave., Mr. View, CA. 94043 (**M4, M5, M9**)
TONER Cable Equipment, Inc., 418 Caredean Drive, Horsham, PA. 19044 (**D2, D3, D4, D5, D6, D7**)
Van Ladder, Inc., P.O. Box 709, Spencer, Iowa 51301 (**M9, automated ladder equipment**)
WAVETEK Indiana, 66 N. First Ave., Beech Grove, IN. 46107 (**M8**)
Western Communication Service, Box 347, San Angelo, Texas 76901 (**M2, Towers**)

NOTE: Associates listed in bold face are Charter Members.

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Manufacturers:

M1—Full CATV equipment line
M2—CATV antennas
M3—CATV cable
M4—CATV amplifiers
M5—CATV passives
M6—CATV hardware
M7—CATV connectors
M8—CATV test equipment

Service Firms:

S1—CATV contracting
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S4—CATV software
S5—CATV billing services
S6—CATV publishing
S7—CATV drop installation
S8—CATV engineering

ommended, but the decision to finalize that recommendation has not yet been made''

Does that mean that until the decision is finalized that any attempt by CATV types to get FCC approval for antennas smaller than 9 meters is a wasted effort? ''No, not necessarily so. We are aware of the intense CATV interest in smaller antennas. We would look at this specific CATV problem if the matter was formally brought to our attention through a test-case filing''. But will the FCC visit the matter on their own, **without** a formal test-case filing?

''Someday — not soon, and not a long time from now,'' is the response.

''What about the application filed by the Gaithersburg, Maryland system that wishes to use a 10 foot horn antenna,'' CATV asked. ''We have read it over''.

''And...''

''And we have no comment''.

''Would that application have been treated any differently if it had been for, say, a **14 foot** horn antenna?''

''No, because it would **still be** smaller than the 9 meter criteria.''

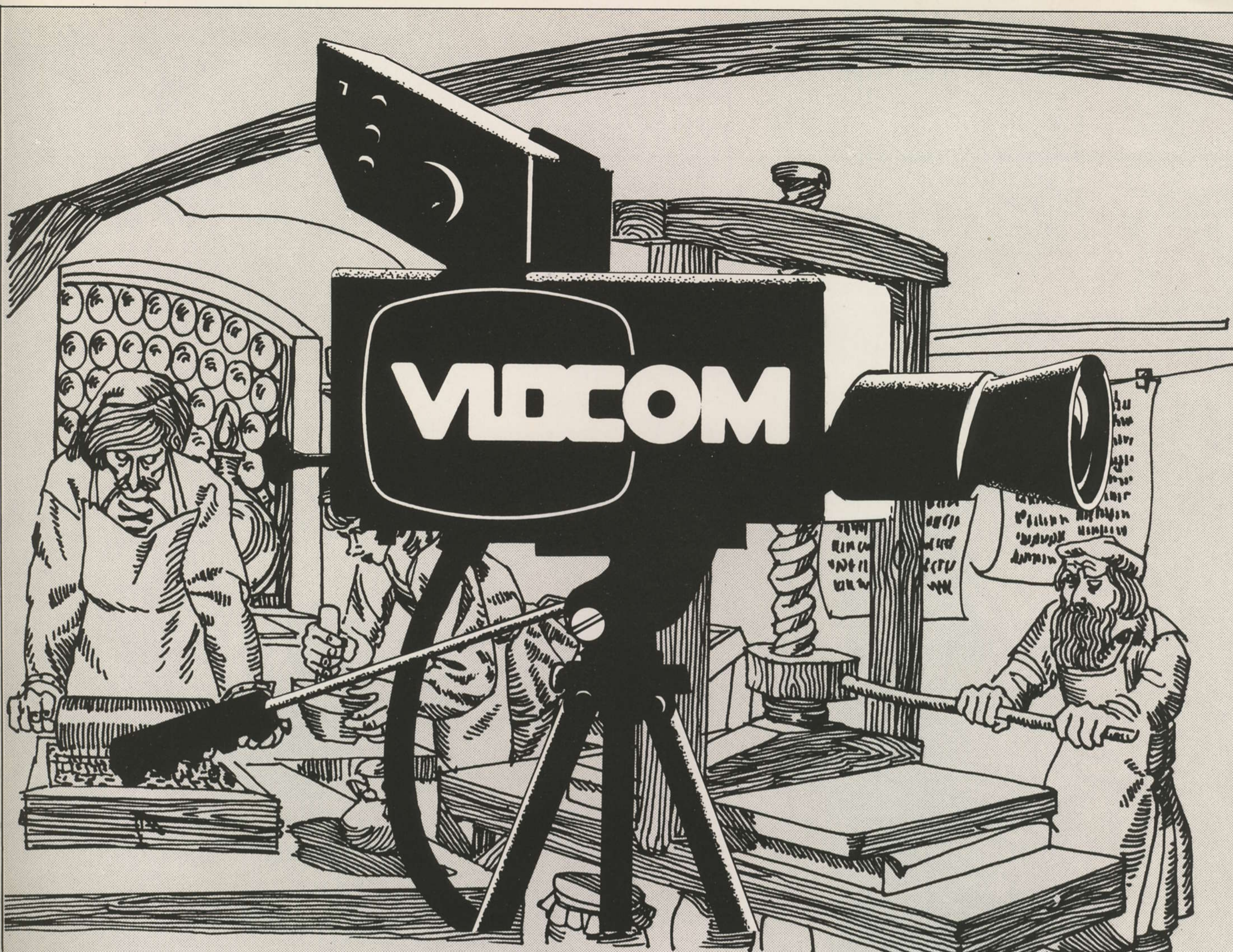
We pointed out that the 10 and 14 foot horn antennas **seem** to meet the 32 minus 25 log theta criteria. And the FCC acknowledged that the Cities Service application for the off-shore rig approved as WB39 **claimed** that **their** 4.5 meter dish also met the 32 minus 25 log theta requirement.

''If the antenna chosen meets the technical parameters which are expressed as a series of antenna pattern measurements, why are we hung up on the 9 meter criteria?'' we asked.

''Because **that is** the criteria,'' was the response.

It is all very baffling. If you have antennas that meet the technical requirements of the 32 minus 25 log theta function, but the antennas do not happen to be 9 meters in size, it appears you have an instant problem at the Commission. 9 meters seems to be much more than an antenna pattern criteria; it has every sign of being a ''**game pass**'' to get into the earth terminal business. Cities Service, RCA and perhaps EXXON are demonstrating that you **can** get around the 9 meter criteria **if** you can show (1) careful frequency coordination and modulation format coordination, (2) and, that there is an essential need for communication purposes with what you are trying to do.

CATV and HBO programming are **not** at the moment considered **essential communication** services. Yet CATV terminals are largely (for now) receive-only. And if the CATV system who had the right to choose between a 4.5 meter dish that would be forever receive-only and a 9 meter or larger dish that could be (optionally) receive **or** transmit, it appears likely that many smaller CATV systems would opt for the receive-only status, and even take the future risk of interference, if they could cut the going-in costs from the present $100,000. figure to the more manageable $25,000. figure.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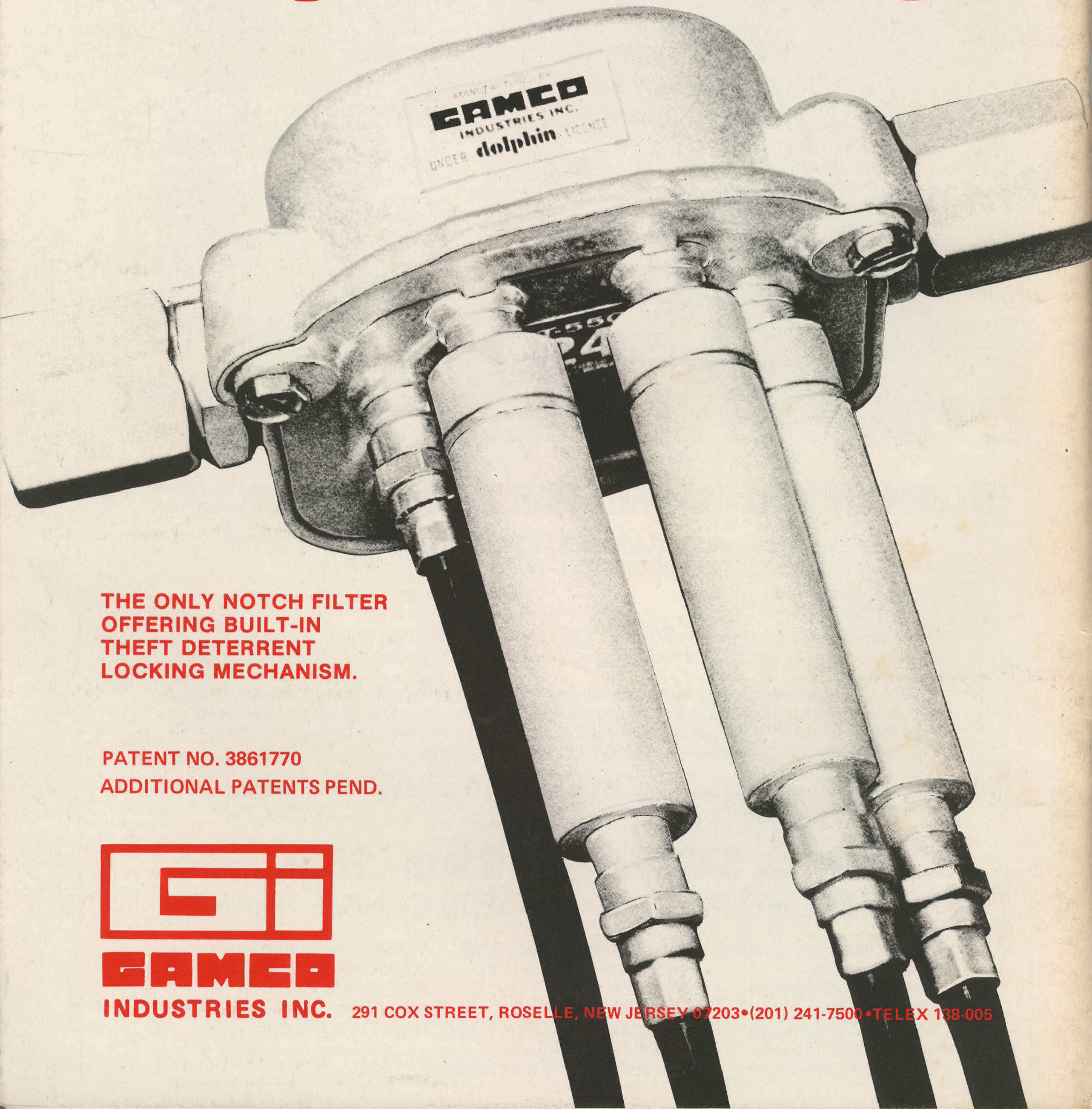

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